Vol. XXXI. October, 1906. No. 4

MUNICIPAL ENGINEERING

A MONTHLY MAGAZINE

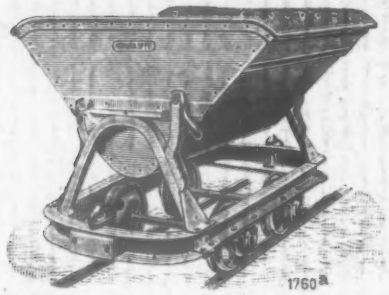
DEVOTED TO THE IMPROVEMENT OF CITIES

CONCRETE CONSTRUCTION. PAVING. SEWERAGE.
WATERWORKS. STREET LIGHTING.
PARKS. GARBAGE DISPOSAL. BRIDGES.

PUBLISHED BY
MUNICIPAL·ENGINEERING·COMPANY
INDIANAPOLIS AND NEW YORK.

Registered in United States Patent Office

Two Dollars Per Year. Single Copies, 25 Cents.



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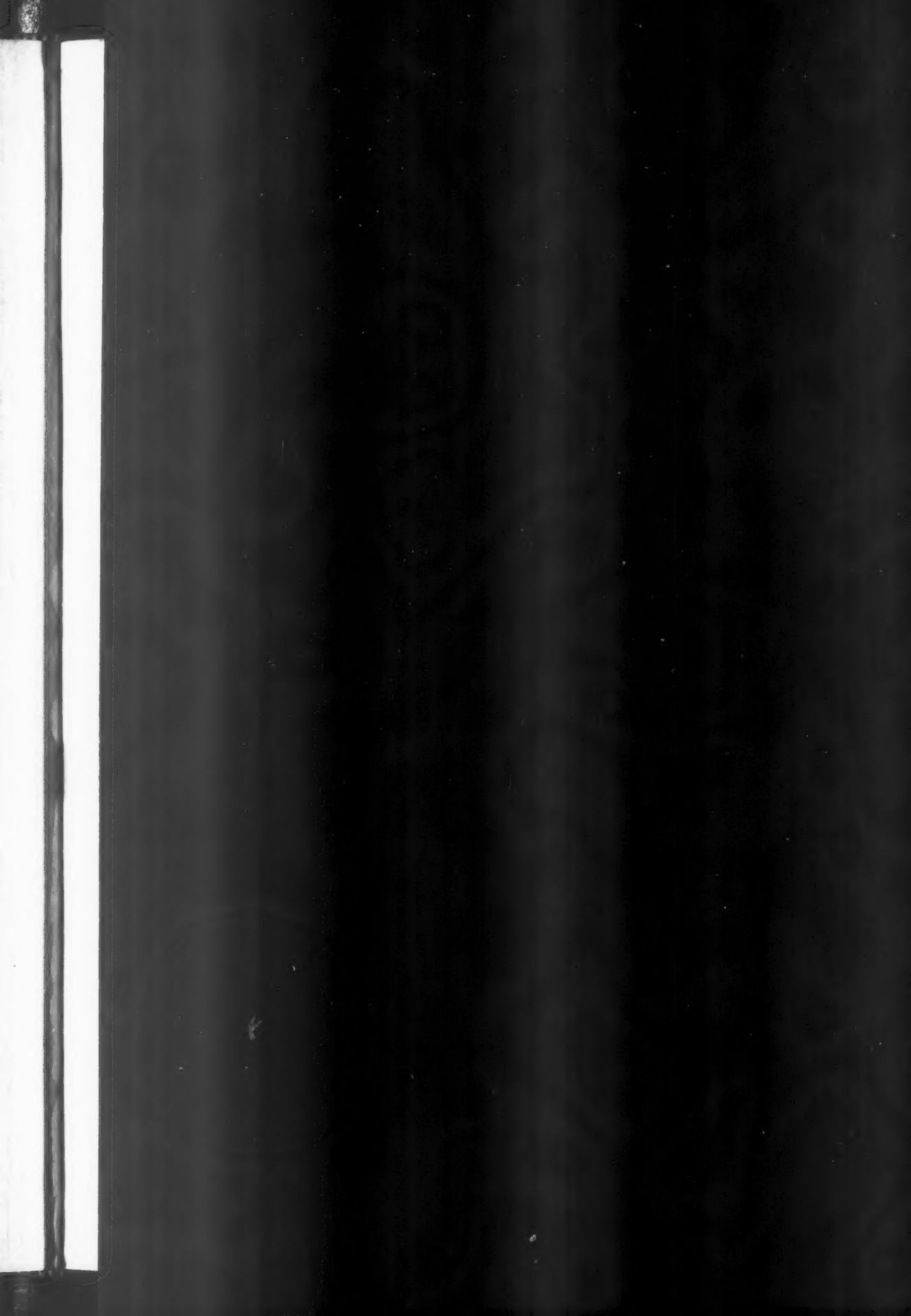
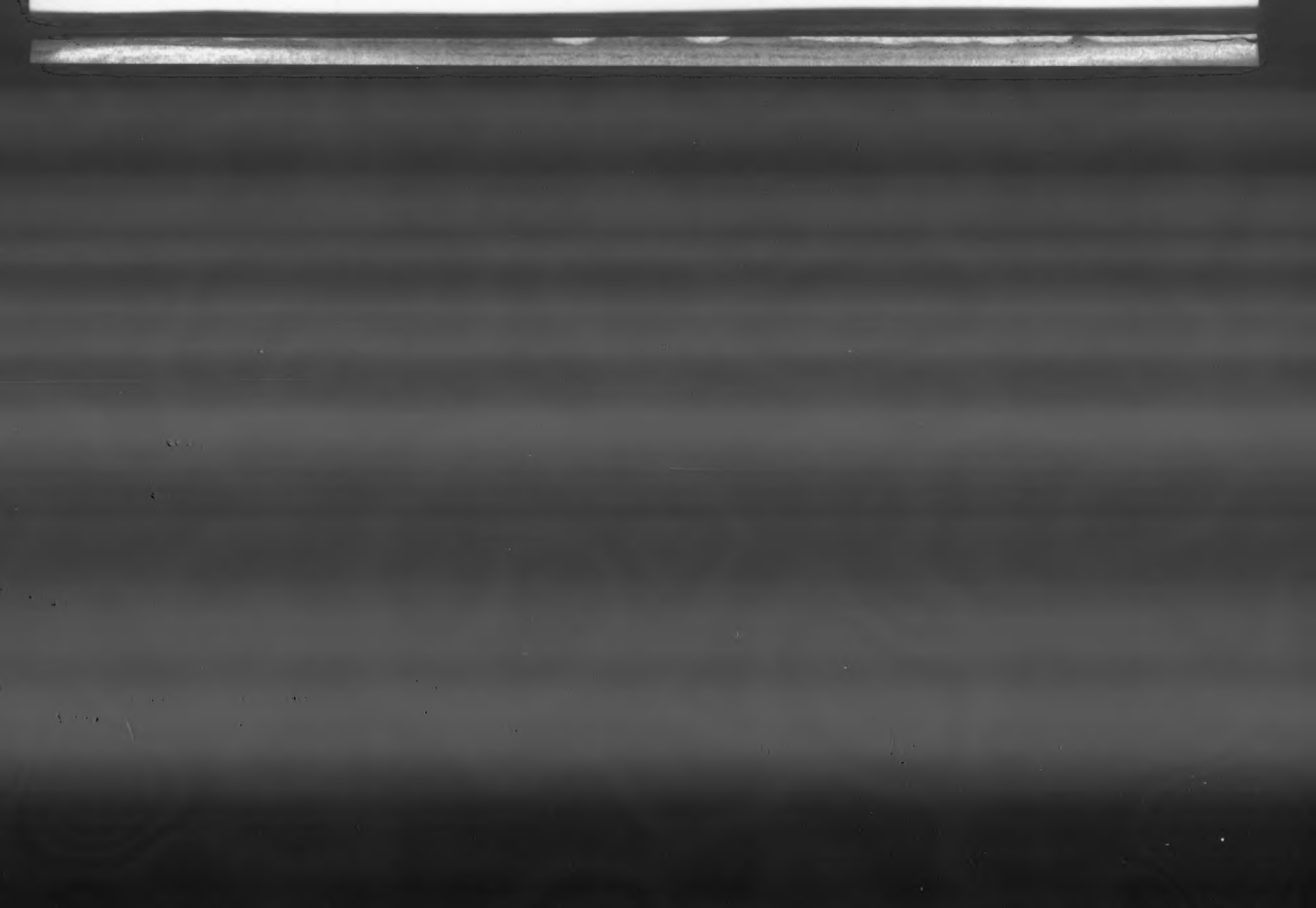




MUNICIPAL ENGINEERING

VOLUME XXXI. OCTOBER, NINETEEN HUNDRED SIX. NUMBER FOUR

THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

PROGRAM OF BIRMINGHAM CONVENTION.

The program for the thirteenth annual convention of the American Society of Municipal Improvements, to be held at Birmingham, Ala., October 9, 10, 11 and 12, has been practically completed and is as follows:

Tuesday, October 9, 10 a. m.—Meeting of the Executive Committee at the Hotel Hillman, headquarters. Meeting of the Finance Committee at same hotel.

11 a. m.—Delegates and visitors will report at Room 23, third floor of City Hall, for registration, badges, credentials, etc. The exhibition of municipal machinery and supplies will be ready for inspection in the Armory on the same floor.

2 p. m.—Opening of the convention in the Convention Hall, third floor of the City Hall.

Address of welcome by Hon. George B. Ward, mayor of Birmingham.

Response by the President of the Society, Mr. Charles Carroll Brown.

The regular order of business will then be taken up as follows:

1. Roll call.
2. Reading of minutes of last meeting.
3. Consideration of applications for membership.
4. The President's address.
5. Report of Secretary.
6. Report of Treasurer.
7. Report of Executive Committee.
8. Report of Finance Committee.
9. Reports of special committees.
10. Reading and discussion of papers.
11. Election of officers.
12. Selection of next place of meeting.
13. General business.

At the first session the first nine of these headings will be covered:

Report of Committee on Exhibits, R. K. Davis, chairman, Hammond Building, Detroit, Mich.

Report of Committee on Municipal Data and Statistics, Hugo S. Grosser, chairman, city statistician, Chicago, Ill.

Report of Committee on Fire Protection, Alcide Chausse, chairman, chief of Bureau of Building Inspection, Montreal, Que.; subject, "Standard Thread for Fire Hose and Hydrant Couplings."

Report of Committee on Park Development, G. A. Parker, chairman, superintendent of Keney Park, Hartford, Conn.

Visit to exhibits in the Armory will follow the session.

8 p. m.—Paper on "The Municipal Control of Planting and Care of Shade Trees," by William Solataroff, secretary and superintendent of the Shade Tree Commission, East Orange, N. J.

Subjects of other papers on parks and time of presenting them will be announced at the opening of the convention.

Report of Committee on Taxation and Assessment, Wm. S. Crandall, chairman, New York City.

Paper by C. H. Rust, city engineer, Toronto, Ont.; subject not announced.

Paper by Lawson Purdy, secretary Tax Reform Association, New York City.

Report of Committee on City Government and Legislation, Thos. J. Neville, chairman, Rochester, N. Y.

Report of Committee on Municipal Franchises, L. H. Weisleder, chairman, Cincinnati and Suburban Bell Telephone Co., 316 Vine street, Cincinnati, O.

Report of Committee on Review, Prof. A. Prescott Folwell, chairman, Lafayette College, Easton, Pa.; Eastern States, by the chairman; Pacific Coast States, by T. D. Allan, city engineer, Pasadena, Cal.

Paper on "The Filter Plant and Pumping Stations of the Birmingham Water Company," illustrated with stereopticon, by John N. Chester, consulting engineer, Pittsburg, Pa.

Paper on "The New Orleans Water Works," illustrated with stereopticon, by Geo. G. Earl, general superintendent Sewerage and Water Board, New Orleans, La.

Selection of committees on Nominations and on Place of Meeting.

Wednesday, October 10, 9:30 a. m.—

Explanatory address on the Birmingham district, by Mr. J. W. Bowron, Birmingham, Ala.

Following this address the convention will be tendered a drive by the Commercial Club and citizens. The route will include the points of interest in the city and

CHARLES CARROLL BROWN,
Pres. A. S. M. I., Indianapolis, Ind.

will be extended across the mountain to the water works station. On the return trip a stop will be made at the reservoirs and filter plant on Shades Mountain, where an old-fashioned Southern barbecue will be tendered by the Birmingham Water Works Company.

8 p. m.—Paper on "The Improvement of Elizabeth River by Eliminating Sewage Pollution," by W. H. Luster, Jr., city engineer, Elizabeth, N. J.

Paper on "The Rational View of Sewage Purification," by Alexander Potter, consulting engineer, 143 Liberty street, New York City.

Paper on "Yellow Fever and Sanitation," by J. N. Hazlehurst, consulting engineer, Mobile, Ala.

Paper on "The Improvement of the Sanitary Condition of Gowanus Canal, Brooklyn," by Henry R. Asserson, chief engineer, Bureau of Sewers, Brooklyn, N. Y.

One or two additional papers may be presented.

Report of Committee on Electric Street Lighting, by E. A. Fisher, city engineer, Rochester, N. Y.

Paper on "Electric Street Lighting," by John I. Mange, manager Watertown Light and Power Co., Watertown, N. Y.

Report of Nominating Committee and election of officers.

Report of Committee on Place of Meeting.

Thursday, October 11.—At time to be announced at the convention, delegates and visitors will take a special train and be taken around the industrial district included in Birmingham and the surrounding municipalities. This excursion is also tendered by the Commercial Club and citizens. The route includes visits to iron ore mines, coal mines, limestone quarries, coke ovens, furnaces, steel mills, rolling mills, water pipe foundries, soil pipe foundries, sewer pipe factories, shale paving brick factories, slag cement works, etc. A light luncheon will be served on the train.

8 p. m.—Report of Committee on Water Works and Water Supply, Julian Griggs, chairman, consulting engineer, Columbus, O.

Paper on "The Cost of Cleaning and Grubbing a Reservoir Site," by Julian Griggs, C. E., Columbus, O.

Paper on "Recent Advances in the

JOHN R. BARLOW,
1st Vice-Pres. A. S. M. I., Montreal, Que.

Purification and Softening of Public Water Supplies," illustrated with stereopticon, by George W. Fuller, consulting engineer, 100 William street, New York City.

Paper on "The Water Works of Archangel, Russia," by Ulrich E. Taubenheim.

manager of water works, Archangel, Russia.

Friday, October 11, 9 a. m.—Exhibition Hall open to visitors.

10 a. m.—Report of Committee on Disposition of Garbage and Street Cleaning, by T. Chalkley Hatton, chairman, consulting engineer, Wilmington, Del.

Paper on "Street Cleaning," by A. Griner, Birmingham, Ala.

Paper on "A Proposed System of Final Waste Disposition for the City of New York," by Howard G. Bayles, Met. Eng., New York City.

Report of Committee on Street Paving, James Owen, chairman, consulting engineer, Newark, N. J.

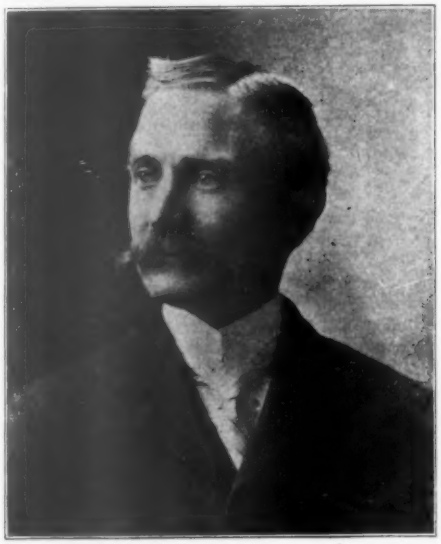
Paper on "The Municipal Asphalt Plant at Hamilton, Ont.,' by E. G. Barrow, city engineer, Hamilton, Ont.

Paper on "An Experience in Oiling a Paved Street," by Frank H. Wright, city engineer, Helena, Ark.

2 p. m.—Inspection of exhibits.

Paper on "Earth Settlements in City Street," by Horace Andrews, consulting engineer, Albany, N. Y.

Paper on "Chert Roads." by Prof. Edgar B. Kay, University of Alabama, Birmingham, Ala.



GEORGE W. TILLSON.
Sec'y A. S. M. I., Brooklyn, N. Y.

Paper on "Paving and Paving Materials of the Southwest," by Walter F. Reichardt, Little Rock, Ark.

Paper on "Tests of Other Wood Than Yellow Pine for Block Pavements," by F. A. Kummer, New York City.

Paper on "Bituminous Pavements Containing Crushed Stone," by J. W. Howard, consulting engineer, 1 Broadway, New York City.

The headquarters for registration, receipt of mail, etc., will be in Room 23, on the third floor of the City Hall, adjoining the convention Hall and the exhibit

F. J. O'BRIEN,
Treas. A. S. M. I., Oswego, N. Y.

hall. Telephones for the use of members will be found in this room, Bell No. 1668, and Peoples No. 661. Mail should be addressed to Room 23, City Hall. Heavy exhibits which cannot be transported to the third floor will be found in a large room on the first floor, which is part of the central fire station.

Members and visitors will be furnished with badges distinguishing them, and officers will wear special badges denominating their offices.

The hotels are the Hillman, headquarters, opposite the City Hall, place of meeting, with rates for rooms from $1.50 to $3.50; the Florence, $1.50 to $4; the Morris, $1 to $3, and the Birmingham, $1 to $2.50, all European, and the last named $2.50 to $4.50, American plan.

Rooms should be engaged as far in advance of the convention as possible.

The Commercial Club and citizens will tender a drive around the city, which will be extended across the mountain to the water works pumping station. On the return trip a stop will be made at the reservoirs and filter plant on Shades Mountain, where an old-fashioned Southern barbecue will be tendered by the Birmingham Water Works Company.

The Commercial Club and citizens will also give an excursion, in a special train, around the industrial district, and the opportunity will be afforded the party to

visit iron ore mines, coal mines, limestone quarries, coke ovens, furnaces, steel mills, rolling mills, water pipe foundries, soil pipe foundries, sewer pipe factories, shale paving brick foundries, slag cement works, etc., etc. Light luncheon will be served on the train.

The Birmingham Railway Light and Power Company will carry all the delegates free on all their lines during the convention week. The wives and families of the members will be provided with trolley and automobile trips.

Notices of reduced rates have been received from the Trunk Line Association, Central Passenger Association, Southeastern Passenger Association and Eastern Canadian Passenger Association, covering practically all the territory east of the Mississippi River and Chicago, except New England.

Delegates and visitors should procure the regular certificates (not simply a receipt) from the ticket agents from whom tickets are purchased, which will entitle them to return ticket at one-third the regular fare if the conditions thereon stated are fulfilled.

Birmingham, Ala., is located in the north central portion of the State. The climate is excellent, the winters being mild, whilst the summers are comparatively cool. The lowest point within the city limits is approximately six hundred feet above the sea level, whilst the suburbs reach elevations of twelve hundred feet above sea level. The city is well laid out with broad streets and avenues, many of which are well paved with granite blocks, vitrified brick or bitulithic. The city also has about forty miles of streets macadamized with chert. The county has approximately two hundred and fifty miles of roads macadamized with the same material. The city is well sewered on the separate plan. The county has recently completed the construction of trunk sewers for receiving the sewage from Birmingham and suburbs, and branch sewers are now being constructed to several of the suburban towns. These trunk sewers were constructed of sufficient capacity to convey the sewage from a population of six hundred thousand. Provision has also been made for constructing disposal works for the treatment of sewage. Septic tanks have already been installed and about four million gallons of sewage per day is passing through them. Plans for additional treatment are being prepared.

Birmingham has an excellent street railway system, embracing one hundred and twenty miles of street railway track and affording good transportation for citizens throughout the city and its twelve suburban municipalities.

Birmingham has an excellent water supply, which is secured from two sources. The North Birmingham station pumps direct into the mains. At this point there is a reservoir of ten million gallons capacity, filters of five million gallons capacity and a pumping station of ten million gallons capacity. The Cahaba pump station has a capacity of twenty-one million gallons, from which point the water is pumped to reservoirs located on Shades Mountain, holding one hundred and fifty million gallons, where it is filtered in the filter plant with a capacity of fifteen million gallons, and is delivered by gravity to the city with a static pressure of ninety-six pounds in the business portion of the city.

Birmingham is the center of the steel and iron industries of the South. Iron ore, coal and limestone are located here, adjoining one another in an almost inexhaustible quantity. There are thirty-two iron furnaces located in this vicinity and two hundred and fifty-seven manufacturing concerns of various kinds, many of which naturally are engaged in the manufacture of steel and finished products from the pig iron.

THE SEWERAGE AND DRAINAGE OF NEW ORLEANS.

The city of New Orleans has been engaged for some six years in the construction of systems of drainage, sewerage and water supply for the entire city, and descriptions of the work have been published in MUNICIPAL ENGINEERING from time to time. Through the courtesy of Geo. G. Earl, the general superintendent of the sewerage and water board, some photographs of details of the sewerage and drainage systems are presented herewith.

In a few words the general plans may be stated as follows: Since the city lies below high water mark in the river and the ground water is very near the surface, it is impossible to drain the city or to sewer it directly into the river or to drain or sewer it all into any other body of water, such as Lake Pontchartrain, between which and the river the city lies. It is possible to drain a large part of the city through sewers and canals, open or covered, into the lake and bayous, but the transportation of sewage in these drainage channels, or its discharge at their

I. MAIN PUMPING STATION "A", NEW ORLEANS SEWAGE SYSTEM.

outlets, would be a sanitary impossibility.

Roughly speaking, the two systems of sewerage and drainage which are thus made necessary, are laid out to run in very nearly opposite directions. Most of the main drainage canals discharge into Lake Pontchartrain, but the city is so nearly level that at least seven pumping stations will be necessary, some of them to lift the water into the relief outfalls to the lake, and one to pump into the main outfall running to Lake Borgne, fourteen miles distant. There is also a pumping station for the portion of the city on the south side of the river.

The main sewer runs approximately parallel to the river and distant from it one-half to two miles, and has along its course two pumping stations which lift its contents into the river. There are or will be twelve or fifteen smaller pumping stations to lift the sewage from branch sewers into the main sewer.

The accompanying photographs show some of these pumping stations. The first shows the main pumping station for sewage, A, in which is being installed the machinery to lift the greater part of the sewage of the city through a 48-inch force main into the Mississippi River. This station also generates the electricity which is used for power in the sub-stations.

The second photograph shows pumping station B, which lifts the sewage from a district in the down stream end of the city into the river. This station is of the same general plan as two of the sub-stations, 14 and 15, which pump sewage from lateral districts into the main sewer, except that it is somewhat larger. They will all be operated by electricity from station A. These three stations were completed this year and are just going into operation.

The third photograph shows station C in Algiers, on the opposite side of the Mississippi River, which will pump all the sewage of this district into the river through a force main.

The fourth photograph is typical of the several substations pumping from district sewers into main sewers. They contain the centrifugal pumps and dynamos necessary to lift the sewage from their districts the short distance necessary to run it into the main sewer and require a minimum of attention, all power being generated at the one station, A, as already stated.

Much engineering skill has been shown in the design of the canals for carrying surface water in meeting the conditions of first cost and maintenance charges, as well as the engineering problems. The fifth photograph shows the interior of the Hagan avenue conduit, which is lined with concrete and covered. The concrete bottom and the reinforcing rods for the side walls are shown in the photograph.

The sixth and seventh plates show the Melpomene outfall canal, the sixth photograph showing the condition of the old canal before excavating, and the seventh the wooden bottom and graded banks with which it was improved. A drainage pumping station is seen at the end of the canal.

The eighth and ninth plates show the construction of the Broad street canal, one showing the interior and the other the top. This canal is lined with wood, as the photographs clearly show.

These photographs show work which has been constructed during the last fiscal year. The reports show that over 67 per cent of the sewerage system has been completed, including the main pumping station, A, and sub-stations, B, 1, 6, 8, 9, 14, 15 and Algiers pumping station, C, of which 261 miles in all have been put under contract since the work began. Of the drainage system 44 per cent has been completed. The cost of the sewerage system to date including outstanding contracts, has been $3,550,000, and of the drainage system, $5,385,000.

THE SEWERAGE OF BALTIMORE.*

By Calvin W. Hendrick, Chief Engineer of Baltimore Sewerage Commission.

Our country, with its cities and towns, has been like a small village, with its houses surrounded by vacant land, ashes and other refuse being disposed of by simply throwing them on the adjacent lot, which being so far away caused no one to complain. The village grows until the lots next door are built on. Then come the dump heaps in the suburbs. As the city grows these are found to be too near to habitation, which means that instead of dumping, it must be disposed of by cremation. During this period the sewerage problem is going through the same trouble. The cities and villages heretofore have been so far apart that the only object in view was simply to get the sewage to a watercourse and then let it

*From a paper before the League of American Municipalities.

II. SUB PUMPING STATION "B," NEW ORLEANS SEWERAGE SYSTEM.

take care of itself. These watercourses have gradually become built on until now it is a serious thing to turn sewage into one of them, as it means your neighbor below will complain, and justly so, and that you will have to find an outlet other than this stream, or abate the nuisance in some way.

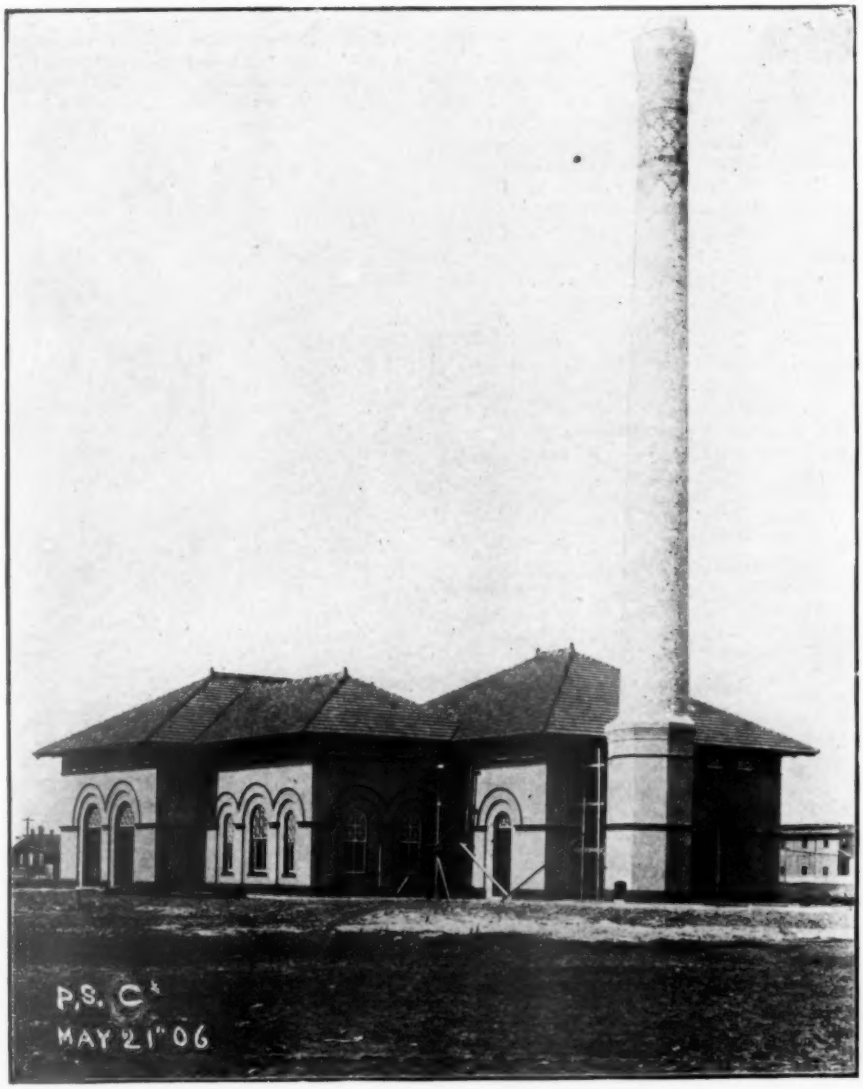
What is the result? A serious pondering and considering of the question of sewage disposal all over the country. The result has been different schemes adapted to different sections of the country.

First, the septic tank in the shape of a well in which the solids settle to the bottom and the liquid rises and flows off. Then come irrigation and sewage farming, by spreading it over large areas of land. Then intermittent sand filtration, where the liquid passes down through the sand and comes out through the underdrains, the solids being removed. Then treatment as in London, where chemical precipitation is used, the sludge being carried far out to sea in specially made vessels. And now we come to the latest and most up-to-date method ever attempted in disposing of sewage on a large scale, and to the City of Baltimore is due the honor and progress to which the engineering world is looking for results. It is a great undertaking. Only a few people realize its magnitude. When you think of preparing to take care of the sewage of a million or more people in a closely built up city like Baltimore, with its very heavy grades, pierced by two railroad tunnels, with two streams dividing the city, which at times grow to raging torrents; with its low lying land around the river front; then to be confronted with an Act of the Legislature preventing the city from using the Chesapeake Bay or its tributaries in the disposal of the sewage, we have a serious problem to unravel. When you come to study the scheme that has been adopted and realize that this sewage will flow to a pumping station, there to be lifted through force mains to a height of 72 feet, an elevation that will allow the sewage to flow by gravity a distance of some five miles to the filter beds on Back River, of such huge proportions that they will be able to treat 300,000,000 gallons of sewage per day and bring it to such a state of purity that it will pass muster with many water systems in the country—this will give you a faint idea of what the great City of Baltimore is about to undertake.

CALVIN W. HENDRICK,
Baltimore, Md.

Baltimore Town, laid out in 1729, is a city that bears the distinction of having started within her borders more modern developments of world-wide importance than any other city on earth. She gave the world the Morse telegraph, the steam railroad, the electric railway, the great Mergenthaler typesetting machine, the first tunnel operated by electricity. A city that has risen without the aid of a single outside person from the ruin and desolation of a fire that almost annihilated it, and that used but a small portion of an appropriation made voluntarily by the State of Maryland—its citizens felt that they would not lean for support even upon their own State. She is a city that has built a court house of such magnificence that it would be difficult to find an equal, with a balance left of the appropriation. She built a magnificent City Hall with a cash balance left of the appropriation. And now, to crown it all, she steps to the front and with vigor and determination takes hold of this gigantic sewerage project. She will soon be a text book for all other cities in this line, as no city has had such restrictions placed on it by the Legislature regarding the disposal of its sewage as the City of Baltimore.

You ask me to describe this sewerage undertaking. I can best begin by saying that we are endeavoring to follow the laws of nature as nearly as possible. For instance, the pump which forces the sewage up into the high level outfall sewer is the sun drawing the salt water from the ocean into the clouds. The flow



III. PUMPING STATION "C," ALGIERS, NEW ORLEANS SEWERAGE SYSTEM.

of the sewage through the great 12-foot outfall sewer is the cloud drifting through the air. Depositing the sewage by sprinkling it through the air over rock concrete beds is the cloud dropping the rain through the air to the earth. The passing of the sewage down through the rock beds is the rain trickling through the earth. The passing out into the settling basins is the river made by numerous springs, and the filtering through the additional sand beds is making it the clear, bubbling spring on the mountain side. You have the various processes through which the sewage passes, which is simply following the laws of God as near as man knows how.

The sewering of the City of Baltimore was an undertaking of such magnitude that His Honor, Mayor Timanus, was authorized by the Legislature to appoint a Sewerage Commission, with himself a member ex-officio. The members of the commission are:: Dr. Ira Remsen, president of the Johns Hopkins University; Mr. Charles England, vice-president of the Chamber of Commerce; Mr. Morris Whitridge, Mr. William D. Platt, Mr. J. Edward Mohler, all prominent merchants and business men of the city, and as chairman, Brig. Gen. Peter Leary, Jr., U. S. A., retired.

The requirements of the Legislature regarding the treatment of the sewage were so exacting, making the solution a serious problem, that the commission called in Messrs. Frederic P. Stearns, of Boston; Rudolph Hering, of New York, and Samuel M. Gray, of Providence, R. I., as a board to recommend the best method of treating the sewage. An interesting report was made on this subject.

In an undertaking of this kind all of its departments are of such magnitude that in some cities a commission is appointed to handle each of them separately. For instance, the pumping station is larger than any pumping station of the water works; the storm water drainage involves the building of storm water sewers for the entire city; the outfall sewer alone represents an outlay of over a million dollars; the disposal plant, an outlay of over three million; the Jones Falls problem alone is an immense undertaking. The tearing up of the streets and alleys means the repaving of certain portions of every one of them, as there will be approximately 700 miles of sewers and drains to be constructed. This does not include the house connections to be carried to the property line, which will add 100 per cent to the above length; therefore, one of the most important steps in the beginning is the proper organization and systematising of the many details in order to carry the work forward rapidly and satisfactorily. The organization was as follows: First, the storm water division. Baltimore's storm water drains were built without any definite plan or design, and are therefore of little use. The commission is practically re-designing and reconstructing the entire system of storm water drains, independent of its sanitary sewerage system, which must be done so as not to interfere with the sanitary system which also covers the same streets. The high level sanitary division, covers all that section of the city lying above a certain elevation; then the low level sanitary division covers the flat section lying around the harbor. Then comes the disposal division, covering the great disposal works located some five miles distant on Back River; then the establishment of the chemical and bacteriological laboratory for the purpose of making experiments and all kinds of tests. Then comes the office engineer in charge of the pumping plant and details, the engineer of drafting, covering all drafting, records, filing, etc. Each division has its corps or field parties. Then come the rules and regulations covering these various departments.

The first step in beginning collection of data to make studies and plans was to make a survey and general map of the city on a scale of 1,000 feet to the inch, this general map showing the watercourses, parks, harbor, rivers, railroads, etc., being the basis for all future investigations. Based on the general map, others were prepared; for instance, a map on the same scale showing the geological condition underlying the city; another showing the distribution of the population of the city, divided into wards as it now exists (this is shown by colors and figures representing the density of population and the number of people per acre); another showing by colors and figures the population as it will be in 1930, at which time it is supposed the city will have a population of 1,000,000, for which number the proposed sewers have been designed another showing the pavements of the city streets as they now stand; another map showing the various drainage areas, another showing the storm water system of the entire city; another the sanitary sewers. One of the difficulties in connection with the last two studies is to build the two complete systems, one for sanitary sewers, and one for storm water drains, so that in the construction and extension of either there will be no interference one with the other.

These maps are what we call foundation or study maps. All of them being on the same scale, it enables one to study

IV. TYPE OF SUB PUMPING STATIONS, ELECTRIC POWER, NEW ORLEANS SEWERAGE SYSTEM.

the city in all its phases. The next step was to make another set of maps on a large scale (100 feet to the inch), and on these are shown all of the existing substructures and every house and lot in the city, thus enabling the engineers to make their estimates and calculations, putting as much information as possible before the contractors to assist them in submitting their bids. Then came the mapping out or dividing up of the city into sections or areas, to show what portions would flow into certain sewers, in order to calculate their sizes. Then came the laying out of the intercepters to find out what portion of the city could be drained by gravity to the distant filter beds on Back River, and what portion would have to be carried to the pumping station, there to be lifted up to the gravity sewer, to flow to Back River. Then the making of wash-borings, to locate the rock line and get samples of the different strata.

The pumping station will require, to begin with, three 27 1-2 million gallon plunger pumps, with additional pumps to be added later. The sewage will have to be lifted through iron force mains to a height of over 60 feet (the friction in the force mains making it equivalent to 72 feet), in order to put it into the outfall sewer, or, as I have just said, the cloud, thence to flow or float, to the point at which it will be rained on to the filter beds.

On reaching Back river, the sewage will first be deposited in huge septic tanks with a capacity of 25,000,000 gallons, where it will remain for six or eight hours, depositing therein much of its suspended matter as sludge, which gradually is reduced in quantity and made inoffensive by bacterial action, and finally is discharged on adjoining lands. The effluent from the septic tanks, which is a partially clarified liquid, flows to the so-called "sprinkling filters." The filters are composed of beds of small, broken stone, about 9 feet deep, and cover an area of 30 acres. The sewage is discharged upon these filters in the form of spray, from a large number of nozzles placed about 15 feet apart at their surface. The sewage filters, or trickles through the beds, a thin film of liquid surrounding each stone, and issues below freed from its putrescent matter.

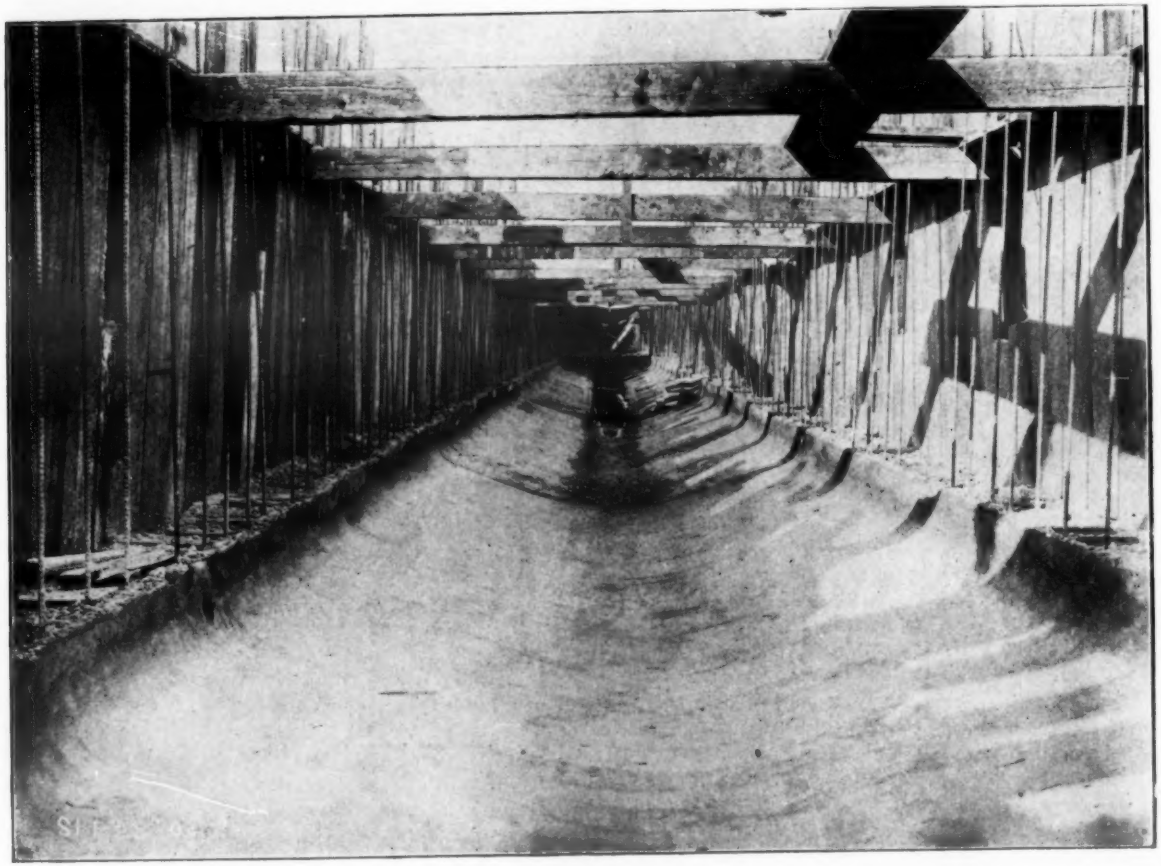
The effluent then enters the settling basins, which have a capacity of 11,000,000 gallons, where it remains about three hours, and deposits the films of matter detached from the sprinkling filters.

The removal of the bacteria by the septic tanks, sprinkling filters and settling basins is about 95 per cent. of the number contained in the original sewage.

The final process of purification is secured by discharging intermittently the effluent from the settling basins upon artificial sand filters, by which substantially all the remaining bacteria and fine suspended matter are removed, so that the final effluent is clear and has obtained the highest practicable degree of purity. These artificial sand filters are to cover an area of 100 acres.

The necessity for purifying the sewage to such an unusually high degree is due to the great oyster industry of Baltimore. The Baltimore oyster is known the world over, and it was therefore considered highly important that not a breath of suspicion should arise in regard to the purity of the oyster. Therefore, the filter beds for purifying the sewage were located on Back river, a broad stream about half a mile wide, and following a very circuitous route some 14 miles in length before emptying into the Chesapeake bay at a point some distance from the nearest of the smallest oyster beds. As the sewage effluent is to be 95 per cent. pure when it emerges from the third step in the process (the settling basins), which is a very high degree of purity, it occurred to the Sewerage Commission, in order not to permit sentiment to burden the city with an undue expenditure, to establish a testing station, a miniature counterpart of the great Back River Disposal Plant. This station will be designed and operated to allow the sewage to pass through the three processes of septic tank, sprinkling filters and settling basins, so that a practical demonstration can be laid before the legislature. If it can be proven to them that sewage raised to 95 per cent. purity would cause no harm to the far distant oyster beds, especially as this highly purified effluent would be discharged into such a large body of water and have to flow about 14 miles before emptying into the Chesapeake bay, at a point far removed from the nearest oyster beds; if the legislature will accept this degree of purity it will save the city the cost of building the intermittent sand filter beds at an expenditure of over $1,000,000 first cost, with an annual maintenance expense of $55,000, which capitalized would mean more than another million of dollars—a saving of over $2,000,000 for constructing these sand filters beds which would give only an additional 2 or 3 per cent. of purity. The commission decided to use one year's interest on the $1,000,000, representing the first cost of these beds, with the hope of saving this large expense to the city.

The difficulties in this great sewerage project are numerous. Baltimore is very



V. HAGAN AVENUE CEMENT LINED CONDUIT, NEW ORLEANS DRAINAGE SYSTEM.

hilly in some sections and very flat in others. Both of these are objectionable features in sewerage construction. For instance, on the steep grades it will be necessary to keep the velocity of the sewage flow down, which will necessitate drop manholes in order to flatten the grades. In the low-lying sections we will be below the tide level, with flat grades. Jones Falls and Gwynns Falls bisect the city, necessitating siphons in some cases, and greatly adding to the difficulties in the storm-water division, as they drain a very large area to the north and west and heavy storms cause them to become raging torrents, overflowing the low-lying sections of the city. There are also two railroad tunnels which pierce the city, one from east to west and the other from north to south, and these have developed serious difficulties.

Baltimore being an old city, it has an accumulation below its streets of a perfect network of pipes of all kinds, some dating back possibly a hundred years. This adds to the many difficulties of construction. When you stop to realize that every house in the city, whether situated on a street or an alley, must be tapped by this new sewerage system, you will then begin to see in a small way what it means.

Most sewerage systems grow up with the city, covering the period from the first settlement, but this system is to spring into existence, you might say, over night. No house can escape, the law making it obligatory upon the Board of Health to see that all houses are properly connected.

In building the sanitary sewers, great care will have to be exercised in order to keep out the ground water, such as rain water and tides, as every gallon that is allowed to enter the sanitary sewers will have to flow to the pumping station and be pumped, and then pass through the filters, which of course adds greatly to the expense.

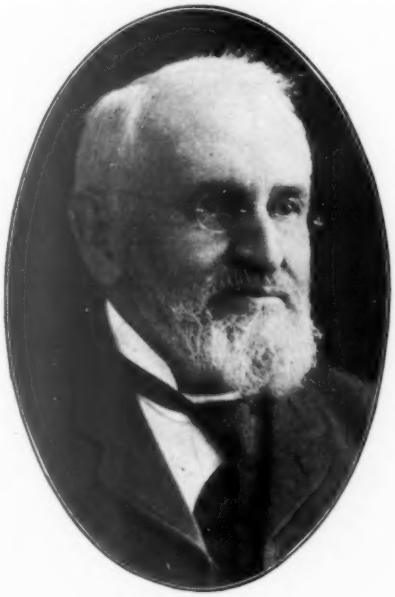
The city of Baltimore has appropriated $10,000,000 towards building the sanitary sewers, and will probably add to this appropriation for the building of the storm-water sewers. In addition to these improvements, large sums have been appropriated for the extension of the park system; the paving of streets; extension of water area; the laying of electric conduits; building of great docks, and, with numerous private enterprises under way, an expenditure of nearly $50,000,000 will be made in the next few years. The spending of such a large sum of money can have but one result, and that is, new life in every line of trade; new people coming in bringing new blood—in fact, the growth of the city in all directions.

A CONCRETE BLOCK HOUSE IN ASHTABULA, O.

Situated as Baltimore is, with its great trunk lines of railroads extending over the entire South, lying on one of the most magnificent harbors with lines of steamships running to all parts of the world, it should rightly be called the gateway to the South and West, and to no one in the city is more credit due for this progressive, up-to-date, businesslike progress than to his honor, Mayor Timanus. It is indeed fortunate for the city that he is handling these matters in a big, broad way, always having in mind the city's interests first and foremost.

A CONCRETE BLOCK HOUSE.

By the courtesy of Henry H. Hall, of Ashtabula, O., the owner and builder, a photograph and some figures of cost of a hollow concrete block house are herewith presented, as a partial answer to many



HENRY H. HALL,
Ashtabula, O.

questions regarding the cost of this kind of structure. Mr. Hall makes no claims that he is an architect or a mechanic, but he has constructed the house by day's labor, being fortunate in securing a competent carpenter as foreman and some good workmen, who constructed the building under Mr. Hall's daily orders.

The photograph shows a double house. Each side has on the first floor a reception hall, parlor, dining room, butler's pantry, kitchen and four-foot stairway; on the second floor four chambers, bathroom, hall, two closets, back porch 8 by 15 feet, and front balcony 4 by 8 feet; on the third floor, three chambers, trunk room 8 by 10 feet; dry room 9 by 24 feet and three-foot stairway to deck roof, which is 12 by 15 feet. The entire finish of the interior is oak, even to the third floor stairway. Each side has a furnace, electric light, gas, sanitary closets in basement and second floor.

The frontage of the building is 70 feet. The blocks were made on a Normandin machine, are 9 by 32 inch face, 8 inches deep, and made of a 4 to 1 mixture. They cost 35 cents each for rock-faced blocks, and 28 cents for the smooth-faced blocks used below the surface and in cross walls. The total cost of blocks was approximately $1,000. The price for laying blocks was 4 cents per lineal foot of blocks.

The walls were furred, lathed and plastered. Mr. Hall thinks no living room should be constructed otherwise, for he finds all rock-faced blocks more or less porous, and, while a troweled face block is not so porous, he thinks the joints will let some moisture through.

The floors of the two balconies are 4 by 8 feet each, and are of concrete 6 inches thick.

The total cost of the house was approximately $7,500. The price of blocks has fallen in Ashtabula to 33 cents since Mr. Hall's purchase was made.

VI. MELPOMENE OUTFALL CANAL BEFORE IMPROVEMENT, NEW ORLEANS DRAINAGE SYSTEM.

EDITORIAL COMMENT

District Water Supplies for Special Fire Protection.

Government Ownership of Public Service Industries.

Development and Retention of Export Trade.

DISTRICT WATER SUPPLIES FOR SPECIAL FIRE PROTECTION.

In a recent number of *Insurance Engineering* appears an article entitled "Steel Water Tanks," which discusses "individual water supplies for congested and manufacturing districts as a remedy for the outgrown water works." The article is as follows:

Enlarging outgrown water works systems to make them cover the older portions of cities more adequately and cover new districts where no protection existed before is expensive and unsatisfactory. The result is sure to be a patchwork affair, unreliable and constantly in need of repairs.

In the cases of towns and cities having single water supplies, as a reservoir, the entire supply may be cut off by an accident to the main distributing pipe or to the reservoir itself. Without pure water for domestic purposes and a proper supply for fire protection, no town or city can long survive.

At the present time the question of increased water supplies is being considered by various cities that have outgrown the systems built in former years. More especially is the need of planty of water for fighting extensive fires being urged upon municipalities in view of repeated conflagrations.

Why not divide our towns and cities into districts and give each district its own water supply? This would give each municipality a series of independent supplies, at a reduced initial cost and expense of maintenance.

The first advantage would be that the water supply in no part of the city would be apt to be outgrown, assuming that it was properly designed according to the character of the district to be supplied.

One practical solution of this question is the steel gravity tank elevated on a trestle at a suitable height to give the required pressure.

A second advantage would be that each district would have a gravity supply, the pressure depending of course on the elevation, and there would be no great loss of pressure due to friction in long lengths of pipe.

A third advantage would be that a public water supply of adequate pressure for automatic sprinklers could be obtained anywhere in a city by this means, as well as a supply for fire hydrants, etc., which would not be affected by an accident to the water supply of any other district.

All the tanks in a city could be interconnected and yet kept separate by the use of gate valves, the latter to be opened only in an emergency. The cost of pumping would be thereby greatly reduced on account of the uniformity of pressure at the pumps, and all parts of a city could have a gravity supply of adequate pressure, regardless of the elevation of one part of a city over another part.

Steel gravity tanks have been built to hold 1,000,000 gallons. The question of foundations, etc., is a comparatively simple engineering problem. A steel tank of 1,200,000 gallons capacity, elevated 220 feet, was recently built for Louisville, Ky., and suggests at least the possibilities of a primary water supply of this character in the congested and manufacturing sections of cities.

Without going into the problem of adjusting the distribution system for each of the proposed districts, which is one requiring special study for each district, some of the facts bearing upon the discussion of the general problem which come to mind may be given.

The first question which arises is as to the sufficiency of the proposed tanks. There is some information in the last report of Mr. I. M. de Varona, chief engineer of the New York department of water supply, gas and electricity, which is of direct application. The fire departments of Manhattan and Brooklyn have furnished him with data regarding the amount of water used at fires. These data show a maximum use of water in a year of less than 100,000,000 gallons in Manhattan, which is about one-third of the daily consumption in that borough. The data for a number of large fires are given in detail. These show the maximum amount of water used in a single fire to be 1,590,000 gallons in a Mott street fire which lasted 106 hours, or nearly five days.

The accuracy of the data quoted may be doubted, however, because the average amount of water used per hour is exactly 15,000 gallons in each fire. The practice of the usual fire department is to use as large an amount of water as possible during the fight to get the fire under control, and then to reduce the amount to that necessary to wet down the ruins. The records of pressure of the Philadelphia high pressure system show the practice in that city, which cannot be far different from that in other cities. For example, on Nov. 27, 1905, an early morning fire required full pressure for about a half hour. A fire the same night required full pressure for nearly an hour, and half pressure for three hours longer. The quantities pumped will probably not vary in the same ratio, but it is evident that the discharge during the three hours of

VII. MELPOMENE WOOD BOTTOM OUTFALL CANAL, NEW ORLEANS DRAINAGE SYSTEM.

lower pressure would not be at the same ratio as during the hour of high pressure. The difference between the two fires shows that an average use of water computed from one fire could not be attributed with accuracy to another. The same average consumption per hour is found in the data for both Manhattan and Brooklyn for the large fires. It is probable, therefore, that the fire departments or the water departments have computed in some unstated manner an average hourly consumption of water at a fire and have applied this indiscriminately to all the fires reported by Mr. de Varona.

However, this method of determining the consumption of water at a fire probably gives too great a consumption of water for a long continued fire, so that for the purposes of this discussion 15,000 gallons an hour is a safe estimate of the amount of water drawn from the pipes during a fire. If we assume the longest continued fire in Mr. de Varona's report, that on Mott street for 106 hours, the consumption of water would amount to 1,590,000 gallons. This is but little more than the capacity of the Louisville tank referred to in the article above reproduced, and the four days and ten hours' time which has elapsed is ample to fill the tank several times over. For short fires, such as the Smith piano factory, three hours, the estimate of 45,000 gallons is probably too small, but if this were multiplied by three it would still be only about one-tenth the capacity of the tank referred to. A tank of 1,000,000 gallons capacity would be of ample size to protect a factory district not too large for maintenance of pressure suitable for fire service, the exact area of the district depending upon the layout of the distribution system.

The value of the tanks in maintaining pressures is evident. The inlet to a tank may even be too small to keep the tank full when the discharge is at the maximum possible rate, and still the tank will take care of anything but a general conflagration. Supply mains which are insufficient for overgrown water systems because they can not keep up fire pressure under the unusual drafts required for the short duration of the ordinary fire, under the district system can be made to serve for longer periods of time because they can be given the necessary time to fill the tanks and their deficiencies in maintenance of pressure can be covered by the supply in the tanks.

In any particular case there will be on the one hand the cost of replacing or duplicating supply mains and of replacing or reinforcing principal distribution lines; on the other hand the cost of putting in the tanks for the districts requiring better fire service, making the connections with supply main and with the distribution, revising the distribution system of the district to the small extent likely to be necessary and putting in the gate valves to isolate the district in case it is deemed advisable.

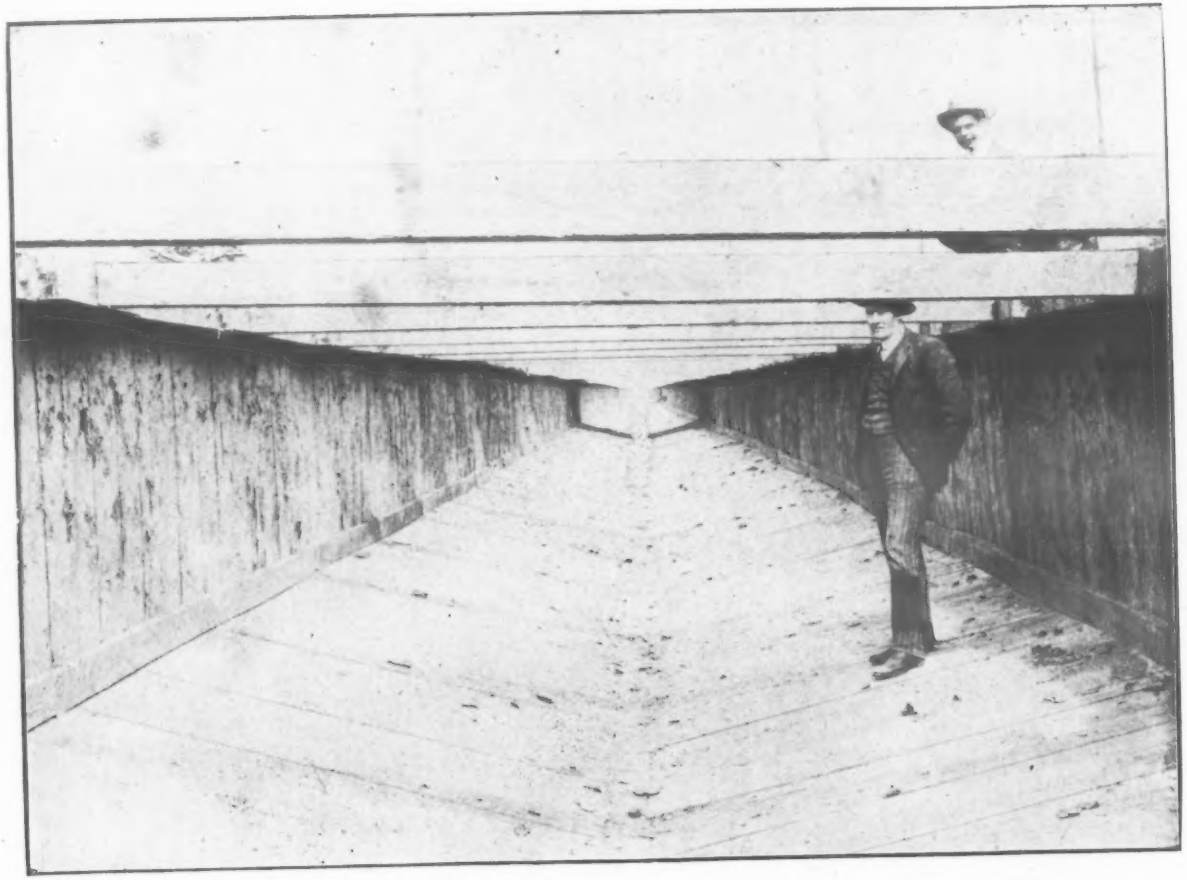
These are only the most obvious benefits of the system. The article closes with a request for criticisms by engineers and others and a general discussion of benefits and disadvantages is invited and communications on the subject will be published when received.

GOVERNMENT OWNERSHIP OF PUBLIC SERVICE INDUSTRIES.

The current discussion, or rather agitation, of the subject of Government ownership of railroads has moved a good many citizens to express their opinions regarding ownership of various other public service industries by the municipality, the State or the Nation, and, whatever opinions may be regarding the question first mentioned, it is surprising to hear so large a number express themselves in favor of "municipal ownership." Whether they have an earnest conviction founded on fairly complete knowledge, may be questioned in nearly every case, but that the sentiment for public control of natural monopolies which properly belong to the people, is becoming strong, cannot be doubted. This may be safely stated to be true, notwithstanding the occasional votes against municipal ownership in particular cases and instances of sale or lease of public service industries to private corporations where public operation has been a failure.

One of the reasons for this widespread expression of opinion is the overthrow of the belief that private corporations were better managed than public departments doing the same work. The revelations brought up by the "muck-rake" have shown not alone the deficiencies in municipalities and states, but the contributions of corporations to these deficiencies or worse, and the mismanagement to which they are subject. The great and far-reaching consequences of the mismanagement of great corporations have dwarfed the comparatively narrow field of the ordinary municipal department until its difficulties and their effects upon the people seem slight in comparison with those of the private corporation which draws into its net people of all classes and from all parts of the land.

It has been shown with a fair degree



VIII. INTERIOR OF BROAD STREET WOOD LINED CANAL, NEW ORLEANS DRAINAGE SYSTEM.

of accuracy that most of the troubles arising in municipal operation of business are due either to the ignorance of the managers of the industries of the details of their business, or to the lack of checks upon their financial operations, which permits the looting of their treasuries or the prostitution of the service to the demands of party politics. We have examples of enough success in operation and in supervision to demonstrate that these troubles can be overcome if we will go about it rightly, and that they are no greater than those to which private corporations with the same careless administration of affairs are subject. We find, also, that the State or the Nation can be successfully appealed to for the necessary expert supervision and police duty and that it should therefore be easier to correct the errors of the municipal department than of the public service corporation. The State Commissions already in existence furnish plenty of evidence in this line.

While, therefore, most thinking students of the question are extremely doubtful of the efficiency of municipal ownership of public service industries under present conditions, nearly all are willing to admit that under proper control, with a surety of the most expert and experienced management attainable, the benefits of the natural monopolies can be preserved for the people to whom they really belong, rather than be presented to the private corporations who exploit them for their own benefit and are very liable to corrupt the municipal legislators and induce the granting of increased privileges and profits.

The idea that a municipal corporation is a business corporation, which has so often been discussed in MUNICIPAL ENGINEERING, is growing. Now the value of the expert supervision which the State can give, and which it should give as the creator of the municipality, is coming to recognition. The revelations of incompetency and dishonesty in private corporations have aroused a sentiment in favor of similar supervision of these corporations, which are equally the creatures of the State and equally subject to its regulation.

Given such a system of supervision the simplicity of direct control of municipal public service industries, rather than through the medium of a private corporation is evident.

The next step toward efficient public operation of such industries seems to be the establishment of the supervisory bodies. Practically the spread of municipal control and municipal operation will be coincident with their establishment.

The Government ownership of railroads is a question of the same class, but the arguments made above are not so directly applicable to it and most of the discussion of it must be upon another basis.

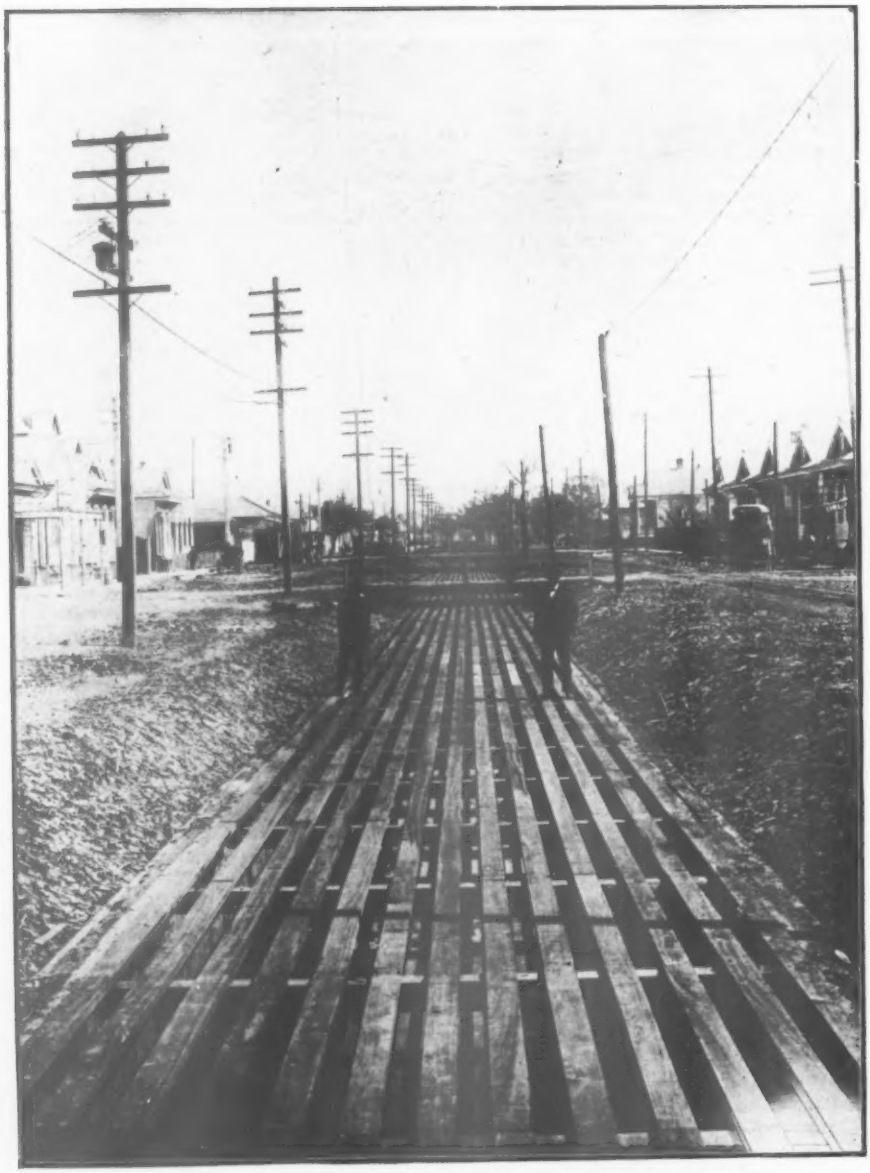
DEVELOPMENT AND RETENTION OF EXPORT TRADE.

Just now it seems useless to discuss the methods of securing and keeping trade with foreign countries, especially in the cement trade which is so fully occupied at the present moment with the problem of of getting together enough cement to fill the domestic demand, but cement plants are increasing in number and capacity, and the present rapid increase in the extension of the use of cement can not continue forever. Some day in the not far distant future the supply of concrete structures will catch up with the demand and the trade must then settle down to a regular basis, which, while large, will not increase with the enormous rapidity of the past ten years. It will not long be possible to increase the production of cement a third each year as has been done for the past five years or more. An eye out for the export trade will find opportunities for getting a start of those who are more absorbed with the local situation.

There are some peculiarities of foreign trade which it will be necessary to learn and to cater to before the trade can be developed and these can not be learned quickly or easily. A little effort and time expended diplomatically while times are good and the trade is making money will give the manufacturer a chance to turn his excess of production into profitable channels when the readjustment begins.

The matter of credits is one which is handled very differently in South American or Asiatic countries from the methods in vogue in this country. Cash on shipment, or even on delivery, can not be expected. Credits are good, but they must be long.

Packing in manner to stand the shipment and the differences in climate must be attended to. Strangely enough, American exporters do not pay the proper attention to this important item and goods are damaged or lost, to the great detriment of the trade there is an attempt to establish. Packages as well as product enclosed in them must conform to the usages of the country to which they are going, or they will have difficulty in overcoming the prejudice against them and in



IX. TOP VIEW OF BROAD STREET WOOD LINED CANAL, NEW ORLEANS DRAINAGE SYSTEM.

favor of an article painted the right color or shipped in the most convenient form of package.

One of the principal complaints regarding American exporter is regarding the attention he pays to inquiries and orders. He seems to consider the export trade only when he is not busy with the domestic demand. Consequently, when he is full of orders he pays no attention to foreign inquiries or even to customers already obtained. As a natural consequence, when he is again ready for foreign trade, he must not only work up a new set of customers, but he must combat the feeling of insecurity which his treatment of the trade in the past has generated.

The would-be exporter who has found difficulty in getting a start will find that a thorough investigation of these and similar complaints will put him in the line of getting the trade because it will give him the necessary knowledge of the difficulties he must overcome and the reasons why he is largely responsible for most of them.

THE QUESTION DEPARTMENT

PLANS FOR CEMENT WATERING TROUGH.

Can you give me any information as to where I can obtain plans for cement watering trough? SUBSCRIBER.

A description of the method of construction of a circular water tank will be found in MUNICIPAL ENGINEERING, vol. xxix, p. 349. A rectangular tank can be constructed on the same lines except the shape of the form. One watering trough in the writer's knowledge has a facing of boulders about the upper edge, but its utility is doubtful where ice is liable to gather.

COST OF REINFORCED CONCRETE FLOORS.

We are figuring on a reinforced concrete building or, to be exact, a building having reinforced concrete and tile floors, in which Kahn bars are used. We would like information as to price per square foot of such floors. Can you recommend to us a good consulting engineer on this subject, or have you books that would help us in making an estimate?

B. K., Petoskey, Mich.

The cost of reinforced concrete work depends so much upon the method of making and placing forms that each engineer or contractor must make his own estimates. The Trussed Concrete Steel Co., Detroit, Mich., and its agents can give you information promptly regarding their system. The names of a number of engineers competent to design the work and estimate its cost will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the headings, "Civil Engineers" and "Consulting Engineers." French & Russell, Moffat Building, Detroit, Mich., and the Keppele Hall Co., U. B. Building, Dayton, O., make special mention of reinforced concrete as their specialty.

Statements of cost of such work at hand vary from about $6 a cubic yard to nearly $40, according to the conditions of the problem and the character of centering used. The impossibility of making general estimates which could be applied to a special case is thus shown.

CONCRETE TANKS AND SILOS.

I want to build a concrete tower and water tank, tower to be 12 feet high, with tank 10 or 12 feet on top of this. Now, can I run these (circular) concrete walls up 10 or 12 feet high, and then make a bottom or floor out of concrete that will be self-supporting by reinforcing and then extend my walls on up 10 or 12 feet more making tower, tank and floor all one solid mass of concrete, and how thick would you recommend walls below and above bottom. Also, could you give me some specifications or guide as to how to build a silo 18 or 20 feet in circumference and 40 feet high?

E. G. W., Deer Creek, Ill.

The structures you describe can be built in the form desired. The design of the tank might be entrusted to an engineer who can compute the dimensions required. The amount of reinforcement in the bottom of the tank and the thickness of concrete will depend upon the diameter of the tank.

A pamphlet entitled "Concrete Construction About the Home and on the

Farm" has been issued by the Atlas Portland Cement Co., 30 Broad street, New York, which gives some valuable general information on its subject. In this book it is stated that the reinforcement in the circular walls of a tank 10 feet deep and 15 feet in diameter should consist of horizontal 1-2 inch rods, spaced 6 inches apart near the bottom, and gradually increasing in distance apart to 12 inches near the top; the vertical reinforcement should be of 1-2 inch rods, spaced 3 feet apart. The thickness of the concrete should be 8 inches. The horizontal rods should be lapped about 2 feet. The wall of the supporting tower, if of plain concrete, 12 inches thick will be sufficiently strong.

The following specififfications are given in the same book for a silo 20 feet in diameter and 32 feet high, with walls 12 inches thick, made by A. G. Brust, superintendent of construction, U. S. Soldiers' Home, Washington, D. C.:

One part best Portland cement.

Two parts clean, coarse sand.

Three parts clean, fine gravel.

Four parts clean, broken stone, brick or terra cotta.

The stone to be broken so that it will pass through a 2-inch ring. Any stone may be used, broken cobblestone being excellent for the purpose. If good clean cinders, free from unburned coal, are procurable, they will take the place of stone. If broken brick is used, it must be hard burned.

Mix sand and cement together thoroughly, and when dry spread out on mixing board and place gravel evenly over same. then on top of the gravel place the stone evenly and spread, after which use sufficient water to make a moderately dry concrete, then throw the whole into a pile in the center of mixing board and turn over twice, place in the mold and ram thoroughly.

The forms are preferably made about 5 feet long for a 20-foot diameter silo. Take 2-inch by 12-inch joist and saw to the outside diameter, using the inside piece to make the inside diameter form. Make forms about 4 feet high and fill to the top with concrete. The filling of the forms should take about one day, or, in other words, the silo should be brought up four feet daily. Set the first form on the foundation, which has been previously put in, see that forms are perfectly plumb, then fill to the top, thoroughly ramming each 6-inch layer of concrete. After concrete has set hard, remove the forms and raise them up so as to lap top of wall about 2 inches, then brace in position and cover top of wall with cement grouting mixed half and half, and fill again, continuing thus to the top. Place anchors in the wall at the top, and make plate of 2-inch by 12-inch joist, cut to form. Make plate of 2-inch thickness, lapping one over the other so as to break joints, and spike thoroughly together. Then put on ordinary shingle roof.

The chute is made of 12-inch terra cotta T's and pipe. Use 2-foot lengths. Alternate lengths of plain pipe and T's are to be used so as to bring the openings 4 feet apart. Use terra cotta plugs when filling, which will be removed as the silo is emptied, thus giving access to the chute from the inside.

Put galvanized iron ventilator in apex of roof. Plaster entire inside of silo with cement and sand in the proportion of two of cement to three of sand, then pebble dash outside.

The booklet also contains specifications of a silo with hollow wall. It can probably be obtained for the asking from the Atlas Portland Cement Co., or its agents.

Taylor & Thompson's "Concrete, Plain and Reinforced" ($5), contains a few pages of descriptions of methods of making concrete tanks; so does Buel & Hill's "Reinforced Concrete" ($5).

CONCRETE FOR FARM BUILDINGS.

Through the pages of MUNICIPAL ENGINEERING would you kindly favor me with any data available relative to the concrete construction of farm buildings as regards cost, etc.?

Also, please state how such cost compares with (a) brick construction, and (b) frame-wood construction.

W. C. G., Philadelphia, Pa.

The U. S. Department of Agriculture issued last year "Farmers' Bulletin No. 235," entitled "Cement Mortar and Concrete; Preparation and Use for Farm Purposes," which gives instructions for selecting cement and other materials and for proportioning and mixing them; also for facing concrete, laying sidewalks, floors, driveways and steps and making reinforced cement fence posts and concrete building blocks.

The Atlas Portland Cement Company has issued a pamphlet entitled "Concrete Construction About the Home and on the Farm," which gives some instruction regarding the construction of many farm buildings in addition to the constructions above named. They include walls, foundations, cisterns, tanks, troughs, piazzas, hog pens, chicken and ice houses, roof cellars, greenhouses, silos and many others, including residences.

As stated in this book, it is impossible to compare the cost of such structures in brick, frame and concrete unless all the circumstances are known. All three vary

with the cost of materials, and brick may be very high where cement is low, or it may be low where concrete materials are very expensive. The booklet referred to gives some data as to cost, showing a photograph of a residence, costing complete $3,850, and giving a table of the materials required for a cubic yard of concrete, so that their cost can be computed for the local prices in any particular place.

The "Handbook for Cement Users"($3) will be found very valuable in supplying specifications, methods of construction and data regarding cost of construction, which can be applied directly to any particular case.

J. A. Bennett, Ravenna, O., built two houses on the same design and of the same size, one all wood with shingle roof, wooden porch and steps; the other of concrete blocks with slate roof, cement porch, steps and concrete chimney. The former cost $1,800 and the latter $2,100. These figures might easily be reversed in another locality. Farm buildings, aside from residences, are less elaborate and cost less in both timber and concrete. Brick construction is ordinarily more expensive than either. Estimates to be of value must be made, however, for the local conditions.

BOOKS ON CEMENT MANUFACTURE.

Have you a book known as "Handbook for Cement Users," and what other leading works have you relating to the manufacture of cement? Kindly let me hear from you, giving prices of books on cement, and oblige.

GEO. E. KIDD, Ottawa, Ont.

The "Handbook for Cement Users"($3) is a book of 369 pages, devoted mainly to the uses of cement, but it has an excellent chapter by one of the leading cement manufacturers upon the methods of manufacture.

A new book, just off the press, by Richard K. Meade, is entitled "Portland Cement, its Composition, Raw Materials, Manufacture, Testing and Analysis." About half of it is devoted to cement manufacture and the materials of which cement is made, particularly the dry process. The remainder of the book treats of the methods of chemical and physical examination and test. The author is a prominent cement chemist in a large cement plant.

Eckels' "Cements, Limes and Plasters" ($6 net) is a large book, devoted entirely to the manufacture of the products named by all the prominent processes in all parts of the country. The author is a competent observer of the field.

There is also a description of English methods of manufacture of cement in Redgrave's "Calcareous Cements."

"The Cement Industry" ($3) contains descriptions of a number of the older American and foreign cement plants.

The third edition of the "Directory of American Cement Industries" ($5) contains short descriptions of all the plants in the United States in 1904. The new edition, 1906, reduces as much of this information as is possible to tabular form and omits the more detailed statements in form of reading matter.

ESTIMATE OF CEMENT PRODUCTION FOR 1906.

Please let us know the price of your latest edition, "Directory of American Cement Industries."

We also wish to know the date of its publication.

We desire to secure information regarding the cement industry in this country, the number of plants, location, capacity, and as far as possible, something of their capitalization.

Do you know the estimated amount of cement for the United States, output for 1905-06? If you have this information, please give it to us, besides what is the estimated output and consumption for 1906-07?

THE LAGARDE LIME & STONE CO.,
New Orleans, La.

The latest edition of the "Directory of American Cement Industries" ($5), which is the fourth, was issued in August, 1906. It gives the information asked for, except the estimates of the consumption of cement for 1906 and 1907.

The production of Portland cement for 1905 was 35,246,812 barrels, according to the latest corrected reports of the U. S. Geological Survey. This is an increase of 33 per cent. over the production for 1904. The average percentage of increase for each year since 1900 over the year before is 33. If we assume the same percentage of increase for 1906 over 1905, the production for 1906 will reach 47,000,000 barrels. The latter figure is about two-thirds the rated capacity of the mills in operation in 1906, so that it is not beyond the easy performance of the mills even when allowances are made for stoppages for repairs, shortage of cars, freezing of supplies for marl plants during the winter, etc. The plants which have begun operation in 1906, or will begin late in 1906 or early in 1907, have a rated capacity of 9,900,000 barrels a year. An increase of nearly 10,000,000 barrels in the supply will be possible for 1907 over 1906. Whether the demand will equal the possibility of supply is a question which can not be answered. If business conditions in 1907 are as favorable as during most of 1906, the production of Portland cement in 1907 may reach 54,000,000 barrels.

CURING CEMENT PRODUCTS BY STEAM.

We would like some information regarding the curing of cement products by steam, the pressure it would take, the length of time required for curing, and the benefit derived by this process. We are expecting to put in a cement drain tile plant, making about 5,000 per day, and would like to use steam for curing if it is a benefit.

H. D. G., Fairmont, Minn.

The only report of experience in curing blocks with steam which has been printed is that of J. P. Sherer, at the Milwaukee convention of the National Association of Cement Users, printed in MUNICIPAL ENGINEERING, vol. xxx, p. 200. He prefers steam under some pressure, but says that the amount of pressure which can be used depends upon the density of the blocks. Porous blocks disintegrate under a steam pressure and only low pressures have been found practicable thus far. The time of curing blocks is reduced considerably, and ranges from 8 to 24 hours, according to conditions of pressure, etc. Mr. Sherer has had some success using exhaust steam, but gets better results with steam under pressure if the blocks are dense enough to stand it.

The matter is still in the experimental stage in several localities. Other reports have not been made public, either because the experiments have not been successful or because the results and the process have been held as a trade secret. Will any of our readers report their failures or successes? Reports of failures will be quite as valuable at this stage as reports of partial successes.

BOOK ON PLASTER MOLDS.

Can you furnish a book that gives practical instruction in how to make plaster of Paris patterns and molds?

LOUIS N. SEASER,
Wichita, Kan.

No such book is known to the writer. Can any of our readers refer us to sources of information on this subject? Will any of them report their own methods in an article for the magazine or as information from which an article can be prepared?

WHAT IS THE BEST METHOD OF GARBAGE DISPOSAL.

Our city is contemplating putting in a garbage disposal plant. Can you kindly advise us which plant you consider the best, and your reasons for recommending it?

A., ———, O.

For a small city the best method of garbage disposal, all things considered, is cremation. It is the cheapest and can be made the least offensive, in fact, can be made practically inoffensive. Until quite recently there has been but little scientifically directed effort to solve the garbage problem and consequently there have been many failures, and but few pronounced successes.

A few engineers have taken up the problem lately and have devoted considerable study to it. Such firms as Hering & Fuller, 100 William street, New York, and the City-Wastes Disposal Co., 156 Fifth avenue, New York, have made special efforts in this line, and the Decarie Manufacturing Co., 23 South Second street, Minneapolis, Minn., has made several successful installations of garbage incinerators from which very satisfactory results have been received. Other methods of garbage disposal are described in the September number of MUNICIPAL ENGINEERING, but the general conclusions, regarding small cities are about as stated above.

ODORLESS EXCAVATORS.

Can you give me the name of manufacturer of automatic vault cleaner? A good second-hand vehicle would answer.

F. B. W., Anderson, Ind.

The Edson Mfg. Co., 257 Atlantic avenue, Boston, Mass.; the Boston and Lockport Co., Boston, Mass., and the Odorless Excavating Co., Boston. Mass., supply such apparatus. The question regarding a second-hand vehicle is referred to our readers.

ARTICLES ON SEPTIC TANKS AND SEWAGE FILTERS.

I would like to secure from your office a list of all matter published in your periodical on treatment of sewage by septic tanks and filter or contact beds.

J. WALTER ACKERMAN,
City Engineer, Auburn, N. Y.

Following is a list of the articles on septic tanks, sewage filters and contact beds in the editor's card index of MUNICIPAL ENGINEERING. There are many other articles on sewage and on sewage and water purification which contain more or less upon the subjects mentioned:

Filters vs. Contact Beds in Sewage Purification, vol. xxvi, p. 111.

Purification of Sewage by Artificially Created Bacterial Filters, ix, 297.

Cost of Altoona's Filter Beds and Sewage Disposal Plant, xi, 152.

A Comparison of Chemical and Septic Tank Systems as Preludes to Artificial Filtration, xxv, 441.

The Discoverer of Septic Tank Action Followed by Filtration in Sewage Purification, xix, 420; xx. 42, 101.

Filtration of Sewage Through Coal, xiv, 29, 248, 333.

The Filtration of Sewage, xiv, 126.

Septic Tank Action Followed by Fil-

tration in Sewage Purification, xix, 420.

Septic Tank System of Purification, xviii, 369.

The Septic Tank, xvii, 158.

The Septic Tank and Storage, xvii, 211.

Sources of Information in the Septic Tank, xvii, 336.

The Septic Tank of the Champaign Sewerage System, xvi, 158.

The Champaign Septic Tank, xvi, 176.

The Septic Tank, xxiii, 153.

The Experimental Septic Tank at Altoona, Pa., xxiii, 193.

The Septic Treatment of Sewage, xiii, 362.

Septic Tanks, xxi, 80.

Plans for Septic Tanks Declared Insufficient for Columbus, O., xx, 102.

Experiments with Septic Tanks in Pawtucket, R. I., xx, 163.

Septic Tanks in Sewage Purification, xix, 52.

Management of Septic Tanks, xxi, 242.

Action of Septic Tanks, xxi, 18.

A New Septic Tank Plant, xxi, 1.

Septic Tanks at Glencoe, Ill., xxii, 1.

Proposed Experimental Septic Tanks, xx, 16.

Septic Tanks at Vancouver, B. C., xxii, 208.

Opinion on Septic Tanks for Large Quantities of Sewage, xxii, 261.

Septic Tanks and Acid Iron Sewage, xxii, 324.

Septic Tank Action, xxii, 337.

Value of Septic Tanks, xix, 350.

A Septic Sewage Disposal Plant, xxi. 1.

Information About the Septic Tank, xxiv, 364.

Bacteria and the Septic Tank, xxvi, 267.

The Septic Tanks for the Treatment of Sewage at the Soldiers' Home near Santa Monica, Cal., xxvi, 1.

Residential Septic Tanks, xxiii, 355.

Septic Tank Treatment of Sewage, xxiii, 396.

Cities Having Septic Tanks for Sewage Treatment, xxvi, 409.

Cost of Small Septic Tanks, xxiv, 432.

Purification of Sewage by Septic Tank Ordered, xxiv, 443.

Individual Septic Tank System, xxv, 90.

Residential Septic Tank System, xxv, 179.

Sewage Purification Plant at the Indiana Eastern Hospital for the Insane, xxvi, 178.

Sewage and Bacterial Purification of Sewage, xix, 429.

The Experimental Bacterial Treatment of London Sewage, xxv, 439.

Results of Filtration of Sewage at Danbury, Conn., xii, 379.

Cost of Altoona's Filter Beds and Disposal Plant, xi, 152.

Purification of Sewage by Artificially Aerated Filters, ix, 297.

Tanks for the Sewage of Small Towns, xv, 101.

Sewage Disposal at Champaign, xiv, 93.

The Septic Tank and Acid Iron Sewage, xxii, 324.

Septic Tank Disposal, xx, 16.

Purification of Sewage by Bacteria, xvi, 100.

The Biological System of Sewage Disposal, xxiii, 357.

Sewage Disposal and the Septic Tank, xxvii, 18.

Books on Sewage Purification by Septic Tanks, xxvii, 23.

The Use of the Septic Tank in Ohio, xxvii, 34.

Sewage Disposal at Plainfield, N. J., xxvii, 37.

Plainfield, N. J., Settles Infringement Suits on Septic Tanks, xxvii, 132.

Sewage Disposal, xxvii, 335.

Patents on Sewage Disposal, xxviii, 233.

Sewage Purification Plants in Ohio, xxviii, 279.

Books on Sewage Disposal, xxviii, 303.

Septic Tanks and Sewage Filters, xxviii, 304.

Cities Having Septic Tanks, xxviii, 448.

Books on the Septic Tank, xxix, 17.

The Columbus Sewage Testing Station, xxix, 34.

Septic Treatment of Sewage in the United States, xix, 36.

The Treatment of Septic Sewage in Triple Contact Beds, xxix, 109.

The Tankage of Sewage, xxx, 36.

Septic Tanks for Regina, Can., xxx, 214.

Sewage Disposal in Septic Tanks, xxx, 350.

Septic Treatment of Sewage, xxxi, 21.

Sewage Purification Recommended for Baltimore, xxxi, 47.

The Sewage Disposal Plant at Downer's Grove, Ill., xxxi, 48.

Purification of Slaughter-House Refuse at Zerbst, Germany, xxxi, 86.

The Origin of the Septic Tank, xxxi, 178.

Disposal of Dye and Wool Finishing Waste, xxxi, 204.

NAMES OF FIRE DEPARTMENT CHIEFS.

Can you advise us where we can get a list of the fire department chiefs of the United States?

G. T. R., ———, Ohio.

There is no such list known to the writer. A partial list can be obtained from the membership list of the various firemen's associations, of which there are

fifty-four state and interstate and district organizations besides the International Association of Fire Engineers, James McFall, secretary, Roanoke, Va.; and the National Firemen's Association, Peter B. McCarthy, secretary, St. Louis, Mo.

Statistics regarding fire departments, which give data regarding the number of men and number and kind of machines, hydrants, alarm boxes. horses, etc., will be found in Bulletin No. 45 of the U. S. Census Bureau for cities of 8,000 to 25,000 population.

PRODUCERS OF NOVACULITE.

Who produce novaculite for road and concrete purposes? J. B. C.,
Indianapolis, Ind.

The Novaculite Paving Co., Equitable Building, St. Louis, Mo., are reported to be the only firm handling novaculite commercially.

DIRECTORY OF WATER WORKS COMPANIES.

Could you inform us if there is a directory of waterworks companies, with the names of their superintendents, managers and engineers? If so, where could we procure a copy of the same?
L. P. C., Pittsburg, Pa.

The "Manual of American Waterworks" ($3) is the only publication of this kind. The last edition is dated 1897, so that it is out of date so far as names of officers is concerned, and there would be many additions of new companies in a new addition.

Bulletin No. 45 of the U. S. Census gives in Table 9, names of cities owning their waterworks, and in Table 4, number of public and private hydrants in each city of 8,000 to 25,000 population, which may be of some value to our subscriber.

STREET RAILWAY TRACKS IN MACADAM STREETS.

In a town where the streets are macadamized and where there are many hills and all sorts of curves of large and small radius, would it be possible to do away with guard rails, or to use a U rail instead of two T rails?

Our council is asking the Street Railway Co. to either do away with their present system of guard rails, which consists of two T rails, or to substitute a U rail. The company maintain that with our present streets, which are only macadam, it would be impossible to use anything else with safety owing to our many hills and sharp curves, there being so many loose stones which are always getting into the guard rail that any but the present system would be of no use. We should be much obliged if you would give us your opinion on the subject. W. B. M., ———, Can.

This subject has been quite thoroughly treated in MUNICIPAL ENGINEERING, vol. xii, p. 7, by E. P. North; vol. xvi, p. 386, by the editor; vol. xviii, p. 249, and vol. xxvi, p. 100, in this department. The last article named gives references to a number of other articles on the subject of street railway tracks in paved streets.

The general conclusion seems to be that the T rail is the most satisfactory for macadamized and unpaved streets, but that it is impossible to make a very satisfactory combination of macadam and rail. The flanged and grooved rail is no more satisfactory from the point of view of the vehicle traffic and is much less satisfactory from that of the street railroad company. The ordinary flat flanged rail is objectionable because it offers an inducement to traffic to try to follow the rails. This makes bad lines along the tracks in the macadam and thus increases the amount of repair necessary for the street surface. The travel on the rails also increases the repair bill for the track, so that this rail would also not be satisfactory to either party. Guard rails would be just as necessary for the grooved and flanged rails as for the T rail and would be equally troublesome to traffic across the tracks.

The city should have some control of the character of the surface between the rails and tracks and should regulate the travel on the streets, so as to make it as convenient as possible.

Under the special conditions named in the above communication, it would seem advisable to keep vehicle traffic off the rails and tracks as much as possible. The guard rails seem to be desirable as a safety measure on account of the steep hills. It should be possible to cross the tracks at all street crossings without difficulty. These requirements may be met by requiring some sort of paving between the tracks wherever they cross a street. This may consist simply of the ordinary plank crossing required of steam railroads, if the rails are not too high. Where there is a curve at the intersection of two streets it may be necessary to put this paving in for the full length of the curve and the tangents between property lines. The supplying of these crossings will in itself regulate, to some extent, the passage or vehicles over the tracks, but it may be advisable in addition to regulate the traffic by ordinance, requiring it to keep off the tracks as much as possible and to use only the paved crossings. If the streets are so narrow that vehicles can not pass along them without running on or close to the tracks, there seems to be nothing which will alleviate the conditions except a

hard pavement of stone, brick, asphalt, wood or bitulithic.

What appears to be a very satisfactory method of paving railroad tracks on a street crossing with heavy traffic is in use in Louisville. Railroad rails, which may be old rails, if the tops are not too badly worn, are laid with bases close together to fill the spaces between rails and tracks. The spaces between the webs of these rails are filled with earth or finely crushed macadam stone, the filling being carried to the top of the rails except for the rail on which the carwheels run. If this filling were of a bituminous paving material it would cost more, but would probably be more satisfactory.

BUILDING CONSTRUCTION

San Francisco Fire—Strength of Brick Masonry—Construction with Concrete Blocks.

Conclusion from the San Francisco Conflagration.*

BY S. ALBERT REED, C. E., NEW YORK CITY.

In the fireproof buildings which were burned out, new data were furnished on the following points:

Reinforced Concrete Floor Arches.—The excellent behavior of this type of floor was noticeable. In the Baltimore fire were several cases of reinforced concrete floor arches; but they were in low, small buildings, and the results, though favorable, did not appear decisive for the reason that quite a number of one-story buildings escaped which had no special construction merits. The behavior of one-story buildings in conflagrations is so capricious, on account of the shelter they sometimes get, that caution must be exercised in drawing conclusions. There was one case in Baltimore of a building with reinforced concrete frame, as well as floors, and it made a good record; but the results were not considered decisive for several special reasons. In the San Francisco conflagration, however, thirty-one fireproof buildings of good height had reinforced concrete floor arches, though all but two had steel frames. Furthermore, fifteen of the buildings had mercantile stocks and most of them were exposed to maximum exterior conditions, although there was, of course, no fire and water test. It was an advantage also that a variety of representative types of reinforced concrete construction were present in San Francisco, the results showing a substantial equality in their ability to stand the test. The type of material in floor arches was cinder concrete in buildings erected previous to 1904; but on account of the scarcity of cinders due to the prevalence of the use of fuel oil, later work used stone concrete. It is doubtful whether the reinforced concrete floor arches which have been through the shock and fire have retained their full strength. In this particular the tile arches have an advantage.

Column Protection.—This was a matter of particular interest. In Baltimore the protection was generally inferior and much of it was wrecked; yet the percentage of column failures was very small. In San Francisco buildings the tile protection was practically the same as that in Baltimore and a number of the buildings with reinforced concrete floors had tile column protection; but there were several types of concrete column protection which made an excellent record. Air space coverings of plaster or cement on metal webbing did fairly well, though several authenticated cases of column failure occurred with such covering. The best results, however, were shown by solid concrete column covering without air space, the concrete being reinforced by metal webbing. It is probable that the air space idea will be in less repute in all future efforts to armor structural steel. It has been shown to be largely fallacious in practice. An air-space with 4-inch brick shell around a column would be good; but would be inconvenient on account of the space occupied. In office buildings as a general thing the duration of the high temperatures is probably short, and, before the slowly conducting column covering has transmitted the high temperature

*Extracts from a report to the Committee of Twenty, National Board of Underwriters.

to the steel, all the combustible material in the immediate neighborhood will have been consumed and a circulation of cooler air begun. In warehouses and even in special rooms of office buildings, where high temperatures are likely to persist for a longer time, the very best column protection is none too good, even at a sacrifice of space. However the results in the Bush Street Telephone Exchange may be considered fairly decisive as to solid concrete column protection, as well as to reinforced concrete floors. The temperatures in this building were not only extreme, but were also protracted. The very excellence of the window protection prevented the air from entering the building at the sides, while the break in the roof afforded just sufficient draft to generate intense and long continued heat. The large quantity of combustible insulation and other material provided ample fuel, and the writer found numerous cases of melted glass. Nearly all the light iron frame work of switchboard apparatus was found collapsed into a heap and even a quantity of wire nails was found welded into a mass; yet the column protection appeared to be perfect and the floor arches were apparently sound. The only breaks, one in the roof and one in the floor below, were at points where cutting away had been done to accommodate some of the switchboard equipment. The bracing effect of the solid concrete encasing the steel column is doubtless an important factor, and it is probable that with such reinforcement the steel might even attain a softening temperature without deflection.

On the other hand, the experience of the Kamm Building should be quoted. Here hollow protected steel columns failed in the basement and wrecked the building. The heat was due to the burning of a stock of wall paper close to the columns and it was probably the time element which was fatal. Non-conduction is impracticable. Delayed conduction is the thing aimed at. It is a mere question of time when a given temperature if maintained will penetrate even solid brick or concrete. Much less time will, of course, be required in the case of such light covering as plaster on wire lath. The fact that so many of the San Francisco column failures occurred in basements indicates that protracted effects are likely to be at their maximum in places where burning material has its combustion retarded by debris. Thus it appears that a column protection adequate on upper floors may be inadequate in basements, so that experience points to the desirability of extra heavy column protection in basements, even at a sacrifice of space.

It must be mentioned that it was a usual thing for careful architects and structural engineers in San Francisco to provide their steel frame buildings with a certain amount of extra bracing on account of uncertainty as to the probable effect of earthquakes on this class of structure.

It is unfortunate that there were no examples in the congested district of buildings of reinforced construction entire, but there was one with vertical supports, girders and beams of reinforced concrete instead of steel.

Column Failures.—One is apt to be impressed by the apparently large number of column failures in steel frame buildings, and it is a fact that a majority of the buildings of this type had some such experience. The gravity of this fact cannot be ignored and points to the necessity of working out a standard for column protection. Yet the percentage figures are not so alarming. An estimate of the percentage of buckled columns to the total steel columns in fireproof buildings gutted by the fire shows it to be about one-half of one per cent.

The character of the collapses is the same as experienced in the Baltimore fire and is also similar to that obtained by the underwriters' tests of 1896, and the Berlin tests of 1893.

General Conclusions on Fireproof Buildings.—The interest attaching to the subject of the behavior of fireproof buildings in conflagrations arises from the fact that their nearly complete structural immunity under such conditions, a matter which must now be accepted as established, has a significance apart from the mere fire salvage. It is no doubt a fine thing for a building to demonstrate its impregnability, and it is doubtless a satisfaction for the public, after a conflagration, to find a considerable number of large buildings which look as if they could be quickly refinished and be ready to go again into service. Yet the actual loss, as demonstrated by the Baltimore experience, will probably generally average over 60 per cent and to underwriters it may be total.

The illusory nature of this salvage is due to the fact that the most expensive part of the usual steel frame building is not the steel, whose original cost in Baltimore averaged 13 per cent of the total original cost, nor the floor arches whose original cost averaged 5 per cent of the total, nor even the brick exterior walls, whose original cost averaged, there, about 15 per cent of the total; but the principal values, viz., 67 per cent, are in other items —such as ornamental stone, decoration, finish trim, partitions, glass, interior light metal work, tiling and marble, plumbing,

wiring and fixtures, together with a large item in mechanical plant; all of which items are apt to be total losses. It will also be noticed from these figures that, inasmuch as the first cost of the floor arches is only 5 per cent of the total value of the building, it makes only 2 per cent difference on the final loss whether, as in the case of the tile arch, 60 per cent is ruined and needs replacing, or, as in the case of the reinforced concrete arch, there may be damage of not over 10 per cent. So long as the fireproofing protects the integrity of the steel frame there is a gain of the 15 per cent represented in the frame itself, though even that is not likely to be of any advantage to the underwriter, except for a trifling percentage due to the saving of time in rebuilding.

There is, however, a significance attaching to the fact that a type of construction may have developed which will take care of itself structurally in a conflagration, in that the problem of securing nearly complete immunity for these buildings is reduced to the one matter of protection of windows and other wall openings, the problem being thus narrowed and defined. The hoped-for character of the fireproof building, as a conflagration break, has been considerably discredited in two great conflagrations; but it has also been shown that the American tall building is, in conflagration, the innocent victim and not the aggressor.

This is contrary to the popular idea, which is that the great peril of American cities is in the tall buildings, forgetting that these are necessarily of fireproof construction, whereas lower buildings seldom are. This country has slight experience of medium or low height fireproof buildings, so prevalent in European cities, because the use of fireproof construction has, on account of expense, here, been confined to tall buildings, where such construction is necessary both on account of structural exigencies and because of municipal ordinances. It is not likely that even San Francisco will be able to resist the demand for permission on the part of owners to reconstruct with wooden beam floors, at least to moderate heights, and certainly no American city in this generation is likely to succeed in enacting a law prohibiting the use of wooden structural material, at least in buildings up to four stories in height. Therefore, for years to come, American cities will consist of tall buildings of fireproof construction, surrounded by non-fireproof buildings, ready under unfavorable combinations of circumstances to develop conflagrations limited only by superior extinguishing methods and by an increase in precautions relating to the occurrence of fires. If such conflagrations are not to involve the valuable fireproofs, the latter must develop a proper system of window protection.

Conditions for Future Water Supply.—It is important to bear all the facts in mind with reference to the matter of damage to the water system on account of their bearing upon the problem of an earthquake-proof water service for the future protection of San Francisco. If we proceed upon the assumption that the city will not again within this era suffer as violent a shock, then, without any radical departure from familiar and approved methods, an efficient system may be projected and created, doubtless with improvements on the present system; possibly under municipal instead of private control. It may be a separate or non-separate fire service, and may include a salt water supply, either primary or auxiliary. New and more frequent distributing reservoirs and mains may be included in the system and a more reliable conduit service may be established, leading from the distant storage reservoirs to those city distributing reservoirs; but the real issue will continue to be whether any system of underground pipes can be relied upon to survive a shock equal to this one. If not, then the most perfect distributing system and the most reliable, abundant and powerful sources will be useless.

It must be borne in mind that San Francisco's water system had an unusual amount of duplication and reinforcement. There were five original sources, three separate conduits into the city, three separate distributing reservoirs, three separate equalizing reservoirs, and five separate high-service tanks. All these were adapted to reinforce one another.

Even a more perfect system of gates, whereby crippled portions may be cut out, would not meet the requirements for a panic-proof as well as earthquake-proof water service. During the first hour of the fire there were 80,000,000 gallons of water in the three reservoirs within the city limits, being rapidly drawn down, of course, by the breaks, but at any rate the point is clear that a shortage of water was not the difficulty. There is no escaping the conclusion that even if San Francisco had had the most perfect water system that can be devised, under ideal management, and with conduits and reservoirs undamaged, yet the breaks of underground distributing pipes, even at a few places, occurring as they would all at once at the critical time, viz., the outbreak of the fire, would have been followed by results not materially different. Salt water mains would have been equally crippled. Steel pipe would not have sur-

vived better than cast iron, breaks involving sheer drops of three and four feet in the street grade.

There is no doubt that the liability to extensive damage may be reduced considerably by observing certain lessons of this event. Omitting, for the present, any consideration of apparently well-founded theories as to the existence of a fault or line of weakness running through the solid formation on a line from Lake Merced to and through San Andreas Lake, which line of weakness should be avoided by future conduits, and confining ourselves merely to considerations which are quite obvious from observations of damage done within the city limits—not only to water pipes, but also to sewer and gas pipes—it is clear that a large part of the liability to damage may be avoided by deep foundations for pipe lines where laid through soft formation. It will also doubtless be possible to make future house connections in a manner less liable to fracture in case of earthquake. Still, in spite of all these possible improvements, there will be a residuum of liability whose seriousness cannot be ignored. The bleeding of water systems by broken house connections is a familiar difficulty during conflagrations; but they usually occur progressively, as one building after another is wrecked by the spread of the fire, and it is conceivable that a highly organized gate manipulation would keep pace, to a certain degree, with the wastage of water; but the case is different where most of the damage occurs instantly. The particular difficulty of broken house connections can, of course, be met by a separate fire main system, but the latter would itself still be liable to break. The conclusion cannot be avoided that, if San Francisco is to have in the future a degree of security on the subject of water supply reasonably approximating that of other cities, the regular pipe system will have to be supplemented by a supply of some kind independent of any underground pipe system.

Municipal and military authorities should be careful how they act in conflagrations in the matter of interference with the individual efforts of citizens to protect their property. In San Francisco the efforts to prevent looting and loss of life probably were effective in saving the owners many thousands of dollars, and may have saved lives. But this very policy was probably responsible for losses of millions which might have been avoided had not owners and occupants been driven out of their own premises by police and military authorities, and by the danger from explosives.

Among the more noteworhty lessons of this fire in the matter of conflagration-fighting are:

1. The importance of front as well as rear and side window protection, fire-resistant if possible, but at any rate fire-retardant.

2. The importance of encouraging individual protection by occupants of buildings.

3. The importance of fire-resisting roofs, roof structures and of well protected skylights.

4. The importance of ample water supply and pressure.

5. The importance to the fire department of a large reserve hose.

6. The importance of fire department apparatus of longer range and heavier calibre. Such apparatus need not be limited by the same conditions of quick response to alarms as ordinary apparatus.

7. Restriction upon the use of explosives in conflagrations.

8. In hollow tile for fireproof buildings, the importance of improved sections giving greater strength to lower webs.

9. The importance in partitions of a better bracing of tile, and the importance of fire retardant transoms as well as doors.

10. The importance of better protection to the steel frame in roof attics.

11. The importance of good bricklaying and mortar with cement instead of lime.

12. The encouraging possibilities of reinforced concrete, and the importance of good engineering in its installation.

13. The necessity of adopting standards for column protection.

The Strength Properties of Brickwork as Determined by Experiment.*

BY W. C. POPPLEWELL, M. SC.

The machine used for making tests of brickwork and similar materials is a 900-ton hydraulic press, having a 20-in. ram. In this machine the pressure of the water above the ram is shown on a pressure gauge. In order to allow for the effect of the friction of the cup leather, the weight of the ram and its attachments, and the upward pull of the side pistons which are used to lift the ram, a direct calibration has been made by which the load on the specimen can be calculated directly from the pressure, with a very fair degree of accuracy. The formula made use of is

$$W \text{ (tons)} = [p \text{ (lbs.)} - 34] \ 0.139.$$

*From a paper read at Manchester at the annual summer meeting of the British Institute of Sanitary Engineers.

This formula has been obtained by means of a steel spring piece which had first been loaded in the Wicksteed testing machine. In this way the load in tons on the specimen can be obtained directly from the pressure in pounds per square inch.

The compressions corresponding to the loads are obtained by means of a Martens mirror apparatus. In this instrument changes of length of the specimen which is being loaded cause the rotation of a mirror, and the reflection of a graduated scale in this mirror, as seen through a telescope, is caused to appear to move across a fixed line in the diaphragm of the telescope. The difference in the position of this line on the scale is a measure of the change of length between two points a fixed distance apart. In the experiments here referred to two mirrors were used, placed on opposite faces of the pier, so as to indicate any inequality in the stress. The readings were taken on a length of 20 c.m. on the face of the brickwork, and readings could be read directly to 1-10,000th of an inch, and by estimation to 1-50,000th.

The experiments which have been made include tests of piers of brickwork, tests of the bricks of which the piers were built, and tests of the mortar used.

All the piers tested have had a square section, 18 in. by 18 in., giving a sectional area of 2¼ sq. ft. Those tested to the present have been 36 in. high, but three which have recently been built are 48 in.

The building of the piers has in all cases been carried out by working bricklayers. Some have been built in place on the lower platen of the machine, while others have been built on stiff squares of timber and moved into the machine when ready for testing. In all cases the top and bottom surfaces of the piers have been set either in neat Portland cement or in plaster of Paris, in order to distribute the load uniformly. This is an important point, and seriously affects the results of the experiments.

The various piers tested up to now include the following::

One of common local wire-cut bricks, with lime mortar.

One of common local wire-cut bricks, with Portland cement mortar.

One of Accrington, with black mortar.

One of blue Staffordshire, with Portland cement mortar.

Six of blue brindle Staffordshire, with two of black lime mortar, two of Portland cement mortar and two of lias lime mortar.

Five of Accrington, with Portland cement, 1 to 1, 2 to 1, 3 to 1, 4 to 1 and 5 to 1.

The results of the first fifteen tests have been published and discussed in a paper published in the "Minutes of Proceedings" of the Institution of Civil Engineers, clxi.

Relation of Stress and Strain.—The measurements taken with the Martens apparatus make it possible to express a relation between the stress and mean strain at any period of the loading.

This relation is conveniently expressed by a plotted stress-strain curve, which is similar to the curve obtained on the first loading of any material having the nature of soft stone or mortar or concrete, in which portions of a harder substance are set in a matrix of a different substance, which is generally soft in nature.

This diagram may be divided into three portions:

(a) There is a curved portion with the concave part upwards. This indicates a diminution of strain as the loading progresses, which may be caused by the spaces between the particles which form the substance being closed up.

(b) The second part of the diagram is straight, thus pointing to an elastic condition of the substance. This elasticity is not quite perfect, as there is generally found a little permanent set on the removal of the load. It is further found, when the specimen has been loaded and reloaded once or twice, that the permanent set is almost completely eliminated. From the readings taken during this part of the loading it is possible to calculate a value of Young's modulus (E). For the best kinds of brickwork (E) has been found to have an average of about 125,000 tons per square foot, or 1,940,000 lb. per square inch. This may be taken to mean that for the application of a stress of 1 ton on each square foot a wall or column of brickwork will be shortened 1-125,000th of its height. For example, in the case of brickwork 100 ft. high, loaded with 12 1-2 tons in each square foot, there would be a shortening, apart from its own weight, of 1-100th of a foot, or about one-eighth of an inch.

(c) At the end of the straight portion the line again becomes curved in the opposite direction from that of the first part. This indicates a growing increase of compression, and marks the end of the elastic condition. If the terminology used in the case of iron and steel be employed here, the point where this last curve begins may very well be called a "limit of proportionality" (P. limit). What is happening in the material after this point is passed is not very clear, but it may be thought probable that the particles, which, up to this point, have retained nearly the same relative positions, are being pushed further out of their

places and a sliding movement is beginning to take place. It is very likely that this movement takes place first in the mortar, and when this begins to move and fail, the even distribution of the stress on the bricks themselves must be changed, with the result that these begin to crack, and a general movement begins to take place throughout the brickwork.

Effect of Successive Applications of the Load.—If a loading is carried just beyond where it has been called the proportionate limit, the load removed, and then again applied, it is found that the measurements taken during the second loading plot on a straight line up to where the previous loading stopped. It would seem that tne effect of the first loading is to press the particles permanently nearer together. The result is very like what is found to take place in similar experiments on some of the metals.

Cracking and Crushing Stresses.—In compressive tests of brickwork it is usual, apart from the elastic measurements, to observe and note the stress at which the first crack is seen or heard, and call this the "cracking stress." The next and the last point reached in the loading is the "crushing stress," which is the maximum stress supported by the brickwork, and at which the material is completely broken up.

That final failure takes place by sliding on planes which are inclined to the axis is shown by the fact that the pier finally breaks up into what are, roughly, two pyramids, just in the same way as is seen in the case of stone. cement and concrete.

The Effect of Mortar on the Strength of Brickwork.—The five piers whose results will now be given were prepared and tested with the idea of finding out to what extent the strength of the brickwork is dependent upon the strength of the mortar. Five piers were built, one kind of brick being used throughout. These were Accrington (Huncoat plastic), with panels on both faces.

On testing three of these bricks for crushing strength it was found that they crushed at an average value of 388 tons per square foot. These bricks were tested whole, and were bedded in plaster of Paris when set on their proper bed. Cement mortar was used throughout, the proportions of sand to cement being different for each of the five piers. These proportions were respectively 1 to 1, 2 to 1, 3 to 1, 4 to 1 and 5 to 1. The mixing of the mortar and the building of the piers were carried out, as in the previous tests, by a working bricklayer. The tests were carried out as described above, the Martens mirrors being used, and each column was loaded about seven times. The first loading was taken up to 16 1-2 tons per square foot, and each successive loading was about 13 1-2 tons per square foot higher, elastic readings being taken throughout. It is worth noticing that in spite of the great care taken to distribute the stress uniformly on the top faces of the piers, the observations showed there was always a greater intensity of stress on one face than on the one opposite; this excess was found to vary from 10 to 34 per cent. The chief results are given in the following table:

TABLE I.

Results of tests of five brickwork piers, 1½ feet square and 3 feet high, made of Accrington bricks and Portland cement mortar. Tested about six weeks after building.

Mortar used: Sand. / Cement.	Prop. limit last time of loading.	First crack.	Crushing.	Ratio—Strength of brick. / Strength of brickwork.	Strength of mortar.	
					At seven wks.	At twenty wks.
	Tons per square foot.				Tons per square foot.	
1—1	85	97	125	3:1	79	98
2—1	80	91	159	2:4	32	51
3—1	78	79	125	3:1	27	28
4—1	72	90	116	4:3	20	24
5—1	72	69	125	3:1	16	18

The mortar was tested in the form of cubes of 4-in. side.

An inspection of these results shows the crushing strength of the mortar to diminish as the proportion of sand increases; also, the strength increased with age. These results are both what one would expect them to be. It will be noticed that only the crushing strength of the mortar is given, as it is found that in tests of this kind the cube collapses very soon after the first crack is seen.

In the case of the brickwork itself, the data obtained are, first, the proportional limit as found from the last set of readings taken in the case of each pier. These agree fairly well with the order of merit of the mortars, though there is far less difference than in the case of the mortars themselves.

In the next column are the stresses at which the first crack was detected. The author thinks this the most reliable criterion of the strength of brickwork, because it marks the point where the stress is beginning to cause internal movement of the material. The same order is maintained, though an exception is to be seen in the case of the 4 to 1 pier. This is probably due to a want of alertness on the part of the observer, whose duty it was to look out for the first crack. The "crushing stresses" in the third column do not appear to follow any particular kind of order, except that the aggregate of the first two is greater than that of the last two. This crushing or collapsing load is always found to be uncertain, and where several piers which are supposed to be precisely similar are tested there may be found to be considerable difference in the final loads, although the cracking points are near together.

It may be well here to quote some of the results of previous experiments in the testing laboratory of the Manchester School of Technology, and already published. These piers were all 1 1-2 ft. by 1 1-2 ft. by 3 ft. high. The stresses are given in the same units as in the last table.

To these may be added a few results recently selected from those published by the Royal Institute of British Architects, and quoted in *Engineering* of June 15, 1906.

In the second table it will be seen that there is a set of piers of Staffordshire blue brindled bricks, which were made in pairs, having different mortars. The second of each pair was twice as old as the first. If the cracking stress be taken as the criterion of strength, it will be seen that there is not a very great deal of difference between the strength of the lime mortar piers and the cement mortar piers, except that the cement mortar fell away in strength while the lime mortar improved with age. Whether this increase of strength would have been maintained if the second piers had been kept longer it is impossible to say.

The difference between the first four and the last two is, however, very marked. This last pier, built with lias-lime mortar, was evidently very bad. It is probable that the mortar was used too long after mixing, when it became partially set. There was no hardening of this mortar, which could be easily crushed between the fingers, and the effect is seen in the strength of the brick-

TABLE II.

Brick.	Mortar.	Age. Weeks.	Cracking.	Crushing.	Ratio—Brick. / Brickwork	Mortar Crushing.
Common wire-cut.....	Sand and lime	4	35	53	5—1	—
Common wire-cut...	3—1 Portland cement	39	64	84	3.1—1	—
Accrington.....	black lime	4	78	96	2.6—1	—
Blue Staffordshire..	3—1 Portland cement	39	69	98	3.6—1	—
Brindle.....	black lime	12	100	165	2.9—1	31.8
Brindle.....	black lime	26	110	185	2.6—1	31.8
Brindle.....	3—1 Portland cement	12	132	169	2.9—1	10.0
Brindle.....	3—1 Portland cement	26	90	161	3—1	10.0
Brindle.....	lias lime	12	38	119	4.0—1	very poor
Brindle.....	lias lime	26	41	102	4.7—1	soft and crumbly

work which is lamentably weak as compared with the first four piers of this set. This may be taken as one example of the influence of the mortar on the strength of the brickwork. The other may be taken from the results of the series given on Table I, already referred to. The five mortars used in this set have a gradually increasing ratio of sand to cement, and

TABLE III.

Strength of Brick Work, R. I, B. A. Experiments.

Brick.	Mortar.	Workmanship.	Crushing strength. Tons per sq. ft.
Blue Staffordshire	Lime	Average	74
"	"	Good	114
"	Portland cement	Average	77½
"	"	Good	119

the results of the tests of the mortars show a corresponding decrease of strength with the increased amount of sand. The brickwork strengths also show a decrease, but not so marked. The strengths of the mortar cubes are approximately in the order: 500, 200, 160, 120, 100, while the brickwork strengths are as 140, 130, 110, —, 100.

It is quite possible that if the mortar had been tested in thin slabs instead of cubes the results would more nearly accord with the brickwork.

There is not a great deal of information published regarding the safe loads that can be applied to brickwork, but from what can be ascertained, the following loads, expressed in tons on the square foot, are often used.

Brick.	Mortar.	Workmanship.	Safe stress Tons per Sq. ft.
Ordinary	Lime	Average	5
Best red	"	Good	8
"	Cement (2–1)	Best	10

A case is quoted of a chimney in Glasgow, where the stress is 9 tons per square foot in still weather, and as much as 15 on the lee side in a gale of wind. In the light of the results quoted here it would appear that the loads usually applied to brickwork are amply safe in most cases. In forming an estimate of the probable strength of any particular kind of brickwork, it is not sufficient to be guided by the names of the materials alone, but to have an intimate knowledge of their quality and the manner in which they are used.

The experiments in the Municipal School of Technology, of which the results have been quoted, were made in connection with the teaching work of the school and the greater number of the observations taken by the students. It would have been impossible to carry out these somewhat costly experiments if it had not been for the apparatus and material provided by the Education Committee of the Corporation of Manchester, to whom the author wishes to take this opportunity of acknowledging his indebtedness and offering his sincere thanks.

Construction with Concrete Blocks.

In a communication to the New York *Sun*, Mr. Alfred O. Crozier, of Little Falls, N. Y., gives the arguments in favor of building construction with concrete blocks and at the same time suggests the defects in most of the work which has been done heretofore under this system. He says:

The unit system of concrete construction was thought to be a possible improvement, a very good advance, over monolithic concrete for the following reasons: First, its safety. Any first-class brand of Portland cement is good, almost always. Every user known that an occasional barrel may be bad. Only by testing each barrel can one be absolutely certain. This would be expensive and impracticable and is rarely done. One cannot tell by the appearance of the cement or of the unset concrete. If not so tested only a failure under the load will reveal the presence of the bad cement. It is then too late. If the concrete had been moulded into units, bricks or blocks, and allowed to set before being used, all danger would have been avoided. Supervision of construction would also be easier. Bad cement is the one constant fear that retards concrete. Get rid of this and the world's construction would soon be upon a concrete basis. Cement makers and users should co-operate to that end.

Second, its strength. "Do not disturb concrete during its initial set," is the warning of the books. Tamping monolithic concrete often disturbs the set of the under layer, injuring its crystalization and strength and leaving a porous unbonded joint. Hand tamping is not uniform and the product varies. Machine made wet process concrete blocks and bricks laid in cement mortar make a wall that can be buaranteed absolutely perfect and uniform throughout every cubic inch, with no flaws. This certainty can be had in no other way. The units will be practically impervious to water.

Third, its cost. Forms for monolithic concrete, erected with high priced labor, cost $1 to $10 per yard of concrete, according to design. There are two buildings of wood, one inside and one outside, to be torn down and destroyed when the concrete put between them has set. It is great waste. The unit system requires no forms. Any design or shape can be produced, and any desired architectural effect. The bricks and blocks are made according to the standard specifications

for concrete. Large, automatic machinery is used. The volume is large and labor required small. The finished units cost about 10 cents per cubic foot, as against 15 to 30 cents for monolithic. Being uniform in size and shape they can be laid rapidly by inexpert labor, so that the complete job guaranteed perfect and flawless will cost much less than the monolithic.

Fourth, its beauty. If your correspondent had seen the pictures of the forty bank buildings in Canada and of other structures of concrete blocks recently erected and exhibited at the meeting of the Concrete Association of New York, he would have been as enthusiastic as were all of the experts present over the possibilities of the unit system as to beauty. No such architectural effects are possible in monolithic work by present methods.

The new $250,000 civil engineering building at Syracuse University, the gift of Mr. Smith, of typewriter fame, is simply a dream of beauty. The concrete blocks were made with some screenings and Portland cement by the wet process, the "rock face" being made by breaking with a chisel before being set too hard.

The only objection to these hand made poured blocks is their cost, which is about equal to sandstone or granite. Only by making them with machinery can their cost be brought below monolithic. Dry process hand machine blocks with pressed "rock face" are without beauty. Not quite as much so, however, as the streaked and uniform appearing surface of the ordinary monolithic structure. While not strong, the greater defect of such dry process blocks is their excessive porosity. Made with insufficient water, no architect or engineer would accept them as concrete.

But units of real concrete, made wet according to the universal specifications for concrete, meet every requirement and seem to point the way for the future.

WATER SUPPLIES

Algae in Water Supplies—Delinquent Water Bills—Pure Water for Rogers Park—Water Meters in Washington—Delaware River Pollution—High Pressure Fire System for Toronto—Horizontal Runs on Air Lift—Fire Protection Problems.

On the Prevention of the Growth of Algae in Water Supplies.*

BY SAMUEL RIDEAL, D. SC. LOND., F. I. C., AND RONALD ORCHARD.

The fouling of reservoirs and conduits in waterworks by various growths is a problem that has frequently to be dealt with by the water engineer, and although it has not attracted general attention in this country, in America, and especially in tropical climates, this contamination of large volumes of water is often a serious matter, and on the Continent several state commissions have had to deal with this subject. The contamination frequently consists of one, or several, of the very numerous algae, many of which, besides causing the clogging of valves, etc., and an unsightly appearance, are capable of imparting disagreeable odors and tastes. Trials have been made to destroy or inhibit the growth of the plants by the addition of a minute quantity of a germicidal substance to the water. Various reagents have been employed in the laboratory to prevent the dense, unsightly growths occurring in the glass outer jackets of Liebeg condensers, which we have found to consist largely of desmids and other unicellular algae allied to *protococcus*. These are inhibited for a short time by introducing strips of bright metallic copper; solid naphthalene gives better results, retarding all growth for a long period.

On a large scale metallic salts such as those of iron or copper have been used. The employment of the latter in the form of crystallized copper sulphate has met with a fair amount of success, the poisonous copper being subsequently precipitated as a basic salt, the coagulating effect of which often renders the finished water very clear and bright.

In the early experiments in this direction by Dr. G. T. Moore, of the United States Agricultural Department, the quantity of crystallized sulphate required varied from 1 part per 1,000,000 to 1 per 50,000,000, while some waters did not appear to be amenable to the copper treatment. He found that the worst tastes and odors are most susceptible. In conjunction with Kellerman he recommends the following dilutions per 1 part of copper sulphate for the destruction of each organism named.

*A paper before the Royal Sanitary Institute of England.

Clathrocystis	8,000,000
Coelospherium	3,000,000
Microcystis	1,000,000
Oscillatoriae	5,000,000

However, we have found that the growth of a conferva (a variety of *spirogyra*) was inhibited, but by no means entirely destroyed, by the addition of 1 part per 1,000,000, in an English lake water. Some forms of algae appear to flourish especially in calcareous waters, and also in those containing quantities of free CO_2; on the other hand we prevented the growth of conferva and desmids in tap water with this gas.

The time required for the subsequent natural precipitation of the copper varies with different waters from some twenty-four hours to twenty days. A soft South African water recently examined in the laboratory did not become clear even in the latter time. This is a serious objection, especially when it is remembered that the coagulum rapidly clogs filters. In some instances a fractional treatment would be more economical. However, the cost of material is in any case insignificant; taking copper sulphate at $140 per ton, the amount for treating 1,000,000 gallons of water with 1 part would cost 37 cents. The chief outlay is always incurred in labor, storage, and the systematic testing of the product for freedom from copper. In a former paper, one of us, in conjunction with Dr. Baines, pointed out that the minute amount of copper required to destroy algae would not be harmful to man. Up to last year the Massachusetts board had declined to sanction employment of copper salts for drinking waters.

In the addition of the germicide to large reservoirs it must be remembered that the solution will diffuse downwards and horizontally any upward movement being too slow. At Newport (Mon.) reservoirs were successfully treated by trailing bags of copper sulphate across the surface of the water, the rate of solution being controlled by the thickness of the material enclosing the salt. Similar experiments at Gloucester waterworks have been successful in removing the spring growth from the reservoir. Trials by the Massachusetts State Board of Health in 1903 and 1904 with copper sulphate gave conflicting results.

A proprietary article, containing "available chlorine," has been advertised for removing the green growth and slime in swimming baths, but we are not aware that any attempt hitherto has been made to employ a solution of chlorine or its oxides for the prevention of these growths in potable waters. Their adoption, however, for this purpose is indicated by their recent successful application, in the form of an electrolytic chlorine solution, for the sterilization of effluents, and certainly laboratory experiments which we have made are very promising. The advantages over the use of a poisonous element, such as copper, are obvious. Even if the treated water was distributed with its full amount of "available chlorine" it would not be harmful in the high dilution employed, but the removal of the chlorine is rapid and very certain. so that the only permanent addition to the water is a minute quantity of common salt. Possibly the staple perchlorate is formed as a final by-product, but the amount is so infinitesimal that it can not be detected. The employment of chlorine alone does not in any way clarify turbid water, but there is no added danger of the subsequent clogging of filters. As with copper sulphate the actual cost of material is low, and electrolytic plants are now on the market which require but little attention when once adjusted for a specified output.

In the laboratory experiments already alluded to an electrolytic chlorine solution obtained from the Digby hypochlorite plant has been employed; this solution, besides having the advantage of cheapness, contains but little undecomposed sodium chloride, and consequently the final addition of chloride to the treated water is very small.

In considering the treatment with electrolytic chlorine, first of all the immediate chlorine consumed figure must be determined, that is to say, the "available chlorine" at once taken up by the organic matter of the water, since obviously in order to successfully inhibit growth the addition of the chlorine should be equal to or in excess of this amount, although in one of our experiments an addition of only half the average Cl. immediately consumed (0.17 part per 1,000,000) decidedly retarded growth in tap water.

The value can be approxiamtely calculated from the oxygen consumed figure, but should be determined directly. The "available chlorine" consumed in five minutes by drinking waters usually falls below 0.5 part per 1,000,000; in two London tap waters it was found to be 0.345 and 0.33 part and with a lake water 1 per 1,000,000.

From experiments made on a large scale at Guildford with tap water purposely infected, it was found that the addition of 0.66 part per 1,000,000 of available chlorine destroyed objectionable bacteria of the coli class in less than one hour, and that the residual available chlorine completely disappeared after some twenty hours' exposure in the large tanks.

In our recent laboratory experiments, quantities of water drawn from the lake in St. James' park were treated with varying amounts of an electrolytic chlorine solution and of copper sulphate. These, together with untreated samples of the water, were kept under the most favorable conditions for the growth of algae. Of course, the growth in all cases was dependent upon the amount of sunlight from day to day, and the best results were obtained in colorless glass vessels with partial aeration. Green glass, and to a lesser extent great aeration, decidedly retard growth. Periodical examinations were made, and when growth was apparent it was examined under the microscope for identification. After some four to seven days all the untreated controls showed vigorous, green, filamentous growths, starting from the bottom of the vessels, which, after a longer period, permeated the whole volume of the liquid. They then became less definite in character and obviously of a mixed nature, owing to the later developments of the numerous other algae present in the lake water. Microscopical examination revealed that the bulk of the growth in the untreated water at first consisted of two varieties of a conferva—*spirogyra*. Subsequently numerous other algae, green desmids, and diatoms, especially *asterionella*, developed. It was found that successful sub-cultures from the lake water experiments could be made into tap water, copious growths being obtained after a week; these were fairly pure, owing to the sharp differentiation caused by the available chlorate added in the original lake water experiments, and a further series was made using the tap water so infected.

As already stated, the immediate chlorine consumed figure of the lake water was 1 part per 1,000,000, and the tap water 0.33; briefly the conclusions arrived at from these experiments were:

1. Green growth can be entirely prevented by the use of electrolytic chlorine.

2. The different microscopic plants decidedly require varying amounts of chlorine to inhibit their development, confervae appearing to be most susceptible to treatment. "Available chlorine" just in excess of that immediately consumed by the water, although disappearing itself in a few hours, inhibited confervoid growth for some weeks. Desmids were found to be slightly more resistant, and in the experiments required the addition of some 0.5 part per 1,000,000 in excess of that immediately consumed by the water. Diatoms appeared to be still more resistant, and required 1 part per 1,000,000 of chlorine in excess.

3. Animalculae, like daphnia and cyclops, are not killed by even larger doses of chlorine, and were found actively motile after a month's treatment with 11 parts per 1,000,000.

4. The addition of 1 part of copper sulphate per 1,000,000 was not successful with lake water, as it did not clarify, and the green growth was only slightly retarded. The effect was not equal to the use of 1.2 parts (0.2 in excess) of chlorine per 1,000,000.

4. Under the microscope a distinct bleaching of the colored algae was noticed with upwards of 2 points per 1,000,000 of "available chlorine"; this can not occur without strong physiological action. An exception to this occurred in Experiment No. 2 (with the lake water) where the desmid, *ankistrodesmus*, was not bleached by 2.02 parts per 1,000,000, and after some four weeks' inhibition appeared to be starting fresh growth.

An important factor, the chemical condition of the treated water as representing that distributed for consumption, was also dealt with in these experiments. In all cases the added available chlorine completely disappeared, 1 part per 1,000,000, added to tap water, could not be detected after five hours, and even in the maximum addition of 11.2 parts per 1,000,000 to the lake water (which is greatly in excess of that required), no available chlorine remained after a few days' sojourn in a partially-filled glass vessel, loosely plugged with cotton wool. In fact, this rapid decomposition of hypochlorites into chloride and oxygen somewhat militates against their use, as in practice the germicide might be removed too quickly, especially by agitation of the water.

The natural chloride, originally present in the lake water, was found to be somewhat high: 14.71 parts chloride per 100,000. The electrolytic chlorine solution contained 0.2 per cent available chlorine and 3.17 per cent sodium chloride (this was employed diluted to one-tenth with distilled water), so that treatment with 2.2 parts per 1,000,000 of chlorine, which was found to preserve the lake water for upwards of a month, required eleven volumes of the electrolytic solution per 1,000 volumes of water.

Theoretically, this increases the total chloride of the water from 14.71 to 16.64. The actual amount found in the treated water was 16.73 parts per 100,000.

In the discussion of the paper, Mr. Read (Gloucester) said that one of the places mentioned where sulphate of copper had been used was Gloucester. They had had a great deal of trouble from algae growing in the bottom of the res-

ervoir wherever light could penetrate, and the growth of this algae had produced a fishy taste and smell. Ten years ago he consulted with the city analyst, and they decided to try sulphate of iron and spread about half a ton over this growth and killed it. The next year, however, there was a great increase in the growth of the algae at the bottom of the reservoir, although it had been cleaned out. Last year he communicated with the Board of Agriculture at Washington, and they sent him a lot of literature on the subject, and mentioned the sulphate of copper treatment. They had to be cautious, as there were fishing rights in their reservoir which were retained by the Lord of the Manor. They decided to try 1 part in 3,000,000. The reservoir contained 30,000,000 gallons of water and they decided to put 1 cwt. of sulphate of copper into the water. This was in the spring of this year. He wrote to Mr. Haines, of Newport, who had tried a similar treatment the year before. Mr. Haines had tried three proportions—1 in 5,000,000, 1 in 1,000,000, and 1 in 500,000. The two former proportions acted all right, but the 1 in 500,000 killed all the fish. He crushed the crystals up to something of the consistency of sugar and scattered them over the surface of the water, and within a few hours a fishy smell arose from the surface, and this continued for twenty-four hours. In Mr. Haines's case, he said that a thick scum was thrown on the surface of the water, but it disappeared in the course of twenty-four hours, and the water clarified. At Gloucester the analyst made tests for copper, and in forty-eight hours no copper could be found by the most delicate tests. As a matter of precaution he did not put the water on the town for a week. Since then they had had no trouble with the fishy smell, and he thought that probably one treatment in the year would be all that would be required.

Dr. Willoughby said that he had used copper where there was a great deal of growth in an ornamental pond. He put 1 cwt. into a small bag and towed it about the pond, and they had had no return of the growth since. He would like to ask if it would be more simple and easy to use chloride. Was there not some chemical which could be used pretty much in the same way as copper was, but which would be much more safe for drinking water?

Dr. Rideal said that practically the only point he had to reply to was that of Dr. Willoughby as to the substitution of a chlorine solution for copper sulphate. If they only required one treatment in the spring it was more economical to use copper sulphate, but, on the other hand, one had to pay attention to the prejudice against the use of copper. In the case of most water works power was available, and it was easy to connect up with such power a small electrolytic plant which would involve an initial outlay of $400 or so, but they would have a plant available to produce their electrolytic chlorine when the growth appeared. Copper was $132 a ton, but if they had a power installation they could buy their salt and produce their chloride as they wanted it.—*The Surveyor.*

Delinquent Water Bill Not Charge on Property.

In a decision rendered September 5, the case of Frank J. Liane, respondent, vs. H. T. Bredes, appellant, was reversed, the Washington supreme court holding that a delinquent city water bill can not be made a lien or incumbrance upon the property. The respondent purchased an ice plant and other personal property from appellant, who agreed to pay off all liens and incumbrances against the property. On taking possession of the plant it was found that $426.95 delinquent water charges had accrued against the owner, from whom appellant had purchased it, and the city of Seattle refused to turn on the water until the bill was paid. The respondent paid the bill under protest, and began action against the appellant for the amount. The lower court gave him judgment. The supreme court holds that the charges were neither a lien nor an incumbrance against the property, and that the appellant therefore did not bind himself to clear off these charges.

Rogers Park, Chicago, Must Have Pure Water.

Mayor Dunne, of Chicago, visited the Rogers Park waterworks plant September 13 and ordered the company to cease pumping, giving instructions that the suburb be supplied with pure lake water through the Lake View station. Mayor Dunne says says that the private company must put in a complete filtration plant, sell to the city at what he may consider a reasonable price, or let its machinery rust from disuse. Corporation Counsel Lewis is of the opinion that the plant of the private company may be acquired by the city under condemnation proceedings. Mayor Dunne says, however, that he does not intend to buy the plant, but does intend to see that Rogers Park citizens get pure water.

Water Meters for Washington.

In an interview with a reporter of the Washington *Star*, September 3, H. B. F. MacFarland, District Commissioner, discussed the installation of meters to stop water waste, as follows:

Under the appropriation of $100,000 given us by congress for the purpose of installing water meters in private residences in this city, we have about 5,000 meters under contract for delivery and already stored at the pumping station with which to begin operations for installation in a few days. By this I mean that we hope to have this total number of meters installed within the ensuing year. Our field equipment, wagons, etc., are at present in readiness, and within a week or so our force will be seen in operation working in the parking in front of residences, putting the meters in position on the intersecting mains, and the water meter system in Washington will become an actuality.

There is considerable misunderstanding on the part of some property holders as to the water meter system, while others with whom I have conversed at once see its strong points. We will begin by placing the meters in the high areas of the city, or points to which we are obliged to pump the water the farthest, leaving the lower levels until the last.

The consumption of water in this city is out of all proportion to its supply and its population, and it is a subject in which I am much interested, both personally and officially. The experts in the water department have estimated that 66 per cent. of the water used in the District is wasted. Placing a low estimate upon the daily consumption at 60,000,000 gallons means theoretically that every man, woman and child in the city uses 200 gallons per day. When it is remembered that 200 gallons approximates seven barrels per capita per day it would seem that we have a population abnormally addicted to the use of the necessary fluid. The need of curtailment is further emphasized by a comparison with the per capita use of water in Providence, R. I., where water meters are in use, and where the per capita consumption is but forty gallons per day.

It is my understanding that next to Buffalo, N. Y., this city uses more water per capita than any other city in this country. Sometimes in the winter in the very cold weather our consumption runs up to the approximate of 100,000,000 gallons per day. In Buffalo, where the supply is practically unlimited, I believe the daily per capita use amounts to 300 gallons per day. This is because our citizens allow the water to run to waste in the winter months.

With our present facilities for obtaining a water supply and the large yearly increase in its consumption, one of two things must be done—increase the plant very extensively at a heavy cost or curtail the use to reasonable limits with the present facilities. and this we are sure that the water meter system will do, so the saving in the end will be very great. In fact, I am of the opinion that in time the water rates will be lessened materially, and certainly the equalization of the use of the water will be attained, for, singular as it may seem to some, it is not the large property holder who necessarily uses the most water, but it is the careless tenants in many of the smaller holdings, where the plumbing is defective, who make no effort to curtail the waste, but, on the contrary, who allow their faucets and other water escapes to run at all hours. The water meters will place a wholesome check upon this large class of indifferent tenants, while the careful householder and tenant will not be materially affected.

Of course, if the water rates are lessened the yearly revenue therefrom must of necessity be lower, but I think this question will settle itself by equalization. Off-hand, the minimum annual water rate for a house 16 feet front and of two stories in height is $4.50. An additional charge of 30 cents is made for each additional story to the house. It will thus be seen that a residence with a large frontage, say of forty feet, pays a comparatively large water tax at present, though the residence may be occupied by man and wife and a servant or two, and the actual use of water in such a residence may be small—in fact, it usually is, as the plumbing in such residences is generally perfect, and the water is not permitted to go to waste.

The meter charge will begin with the fiscal year next ensuing July 1, 1907. Householders should see to it that their faucets are kept tight, their plumbing in good order throughout. and that continuous faucet running and closet flushing is stopped. We can only estimate the amount of water used per annum by the government in the District, and it is put down at about 10,000,000 gallons per day. Perhaps congress will give an appropriation for water meters to be used in the government service, when this amount may be accurately ascertained, and I am in favor of the use of meters by the government. The municipal government, we estimate, uses about 2,000,000 gallons per day. I think the meters should be universally installed in every government

business and private house in the city, and I look forward to this ultimate result.

Now that the meters are really going underground, householders in this city should bear these important facts in mind:

The rate to be charged for water supplied through meters will be 3 cents a hundred cubic feet, one cubic foot approximately equaling seven and one-half gallons. The minimum rate of meter charge will remain the same as the minimum water rate—$4.50. In case of premises required by law to be supplied with water by meter, the supply of water to any portion thereof, for any purpose, shall be determined by meter. In every case where dwelling houses or tenements are occupied also for business purposes, or vice versa, the regular charge for domestic purposes according to the regular rate shall be made, and, in addition thereto, the special business rate which has been fixed for various businesses by the water department. In cases where a story is used entirely for business purposes, however, it will not be reckoned in the charge for domestic purposes. A "story" of a building is held to include basements, cellars and attics containing space used or fitted out for domestic purposes, unless this space be used exclusively for kitchens, laundries, storage rooms or bath rooms.

Joint Action Against Delaware River Pollution Proposed.

At a joint meeting held at Atlantic City, N. J., September 14, representatives of New Jersey, Pennsylvania and New York adopted plans for the three States to stop, by united action, the pollution of the Delaware River. New Jersey has already, in the last five years, accomplished much in compelling cities and towns to install modern sewage disposal plants. Pennsylvania and New York departments, more recently organized, have started on the same course, but the three States agreed that by mutual action the desired object can be more easily attained.

High Pressure Fire System for Toronto, Ont.

The pumping station for serving a high pressure fire system for Toronto, Can., possesses several features of unusual interest. The entire station equipment is of the turbine type, power being furnished by steam turbines and the water pressure by multiple stage turbine pumps.

The service to be rendered by this station will be similar in character and extent to that of the Philadelphia high pressure pumping station, now familiar to the public and which is driven by gas engines. As is the case in Philadelphia, the Toronto service plant will supply water at a maximum pressure of 300 lbs. per square inch to a high pressure piping network, covering the district to be protected. Hose connections are made direct, this dispensing entirely with the use of fire engines in the locality.

For the present the new high service equipment will comprise two turbo pumping units having a capacity of 5,000,000 gallons per 24 hours at 300 lbs. maximum head. It will be installed at the main pumping station, where steam power is at all times available. This fact was important and probably the preponderating one in the decision of the city to install steam driven, in place of gas driven apparatus, as the expense of maintaining an individual steam plant under full pressure would have been prohibitive.

Motive power for each pumping unit is supplied by an 1,100 h. p. Westinghouse-Parsons steam turbine. They operate on dry saturated steam at 150 lbs. Pressure and a moderate vacuum of 26 inches is supplied by a condenser of the simple jet type. As the highest economy was not considered of paramount importance in this case, the simplest form of condensing plant was adopted. Independent operation is assured by the use of one condenser for each unit. In order to enable the turbines to sustain full load in case of condenser failure, a secondary valve may be used which at the same time gives the unit an overload capacity of 50 per cent or more when running condensing at the usual speed. An important feature in the operation of the plant will be the speed control of the pumps, which will, of course, be necessary to secure the desired variation in delivery pressure to meet the exigencies of fire fighting. This will be done largely by hand, and provision has been made for a 30 per cent variation in speed below the normal speed of 1,500 revolutions per minute. As an auxiliary feature, the governor operates as an automatic safety stop, preventing the turbine unit from reaching a dangerous speed should any part of the regular governing mechanism get out of order; this being accomplished by instantly shutting off the steam supply to the turbine.

In the specifications drawn up by the city engineer it was stipulated that either turbine or pump should be capable of disconnection for inspection or repairs without disturbing the adjustment of the remaining half of the unit. This is readily

accomplished by a split coupling of the flexible type. As turbine and pump each has two bearings, the two parts of the unit are thus independent.

Although the centrifugal pumps are not particularly designed for steam turbine driving, yet in this case the design is well adapted for direct connection to steam turbines. They are of the two-stage turbine type. An important and essential feature in the design is the provision of diffusion vanes by which the water delivered by the pump impellers is brought approximately to rest under the static head of 150 lbs. per stage. Furthermore, the pumps have been designed so that the dynamic forces acting in the direction of the shaft are approximately balanced, thus relieving the turbine shaft from axial thrust. The pumps take water axially at the center under a suction head of 10 to 15 ft., both delivering into a horizontal 24-inch main connected with the high pressure system. In cases of large fires and high buildings where maximum pressure head is necessary, the two pressure stages will be operated in series; where lower pressure is desired, the speed of the unit will be reduced in proportion. In case of small fires, however, where only moderate pressures are required, one pump stage will be eliminated by a by-pass valve delivering suction water directly to the succeeding stage. These valves will be electrically operated.

The complete pumping units are extremely compact, being only about 25 inches in length over all, and set at 10 ft. centers. This close spacing is largely due to the possibility of locating the condensing plant for each turbine directly beneath it in the foundation.

The operation of a high pressure fire system, such as is being installed at Toronto, presents many novel conditions not arising in ordinary power work. Principal among these is the necessity for quick starting.

How Horizontal Runs Affect the Air Lift.

BY HERBERT T. ABRAMS, MEM. AM. SOC. M. E

In the application of compressed air for pumping, more particularly in connection with the operating of deep wells, the air lift system finds its broadest field, and in this particular work has advanced year by year in public favor, as is evidenced by the number of new installations, both private and municipal.

Briefly, the reasons for the popularity of this method of pumping in water, oil and salt well propositions are the advantages claimed by the trade. Absence of working parts in the well, low maintenance charges, assured maximum yield from any well, and the central plant pumping any number of scattered wells.

All of these claims are acknowledged generally, in fact are indisputable, there being but one reservation in the mind of the engineer and that concerns the question of economy, meaning power consumption alone, without any reference to final savings made through the installation of an economical air lift system.

We have to deal in this article with one of the limitations of the air lift system, and as far as the writer knows, one in regard to which little information is at hand.

It is frequently necessary to deliver water to an elevated tank or reservoir at some considerable height above and distance from the well, in which event it has generally been considered inefficient to make the lift at the well force the water horizontally and end with a lift to a tank, but to just what extent the problem was affected by these conditions has always been a matter of guess work. Confident, however, that serious disadvantage attached to forcing water from a well a long distance, the practice has been, wherever possible, to avoid doing so by substituting either:

1. Vertical lift at the well high enough to flow the water by gravity to the desired point, employing standpipes; or,

2. Raise the water to a surface reservoir or cistern near the well and deliver the water above ground by means of an ordinary pressure pump, or a pneumatic displacement pump, submerged directly in the receiving tank or reservoir, thus through a combination of the air lift and pneumatic pump rounding out the whole operation as a complete compressed air system of pumping.

Either of the above methods is preferable to the continued use of the air lift system under such conditions as we are about to consider, but circumstances often prohibit these alternatives or the question of first cost may demand a figure based on making the lift direct with the air lift, and to meet such it is necessary to know what this additional work amounts to.

The writer recently had occasion to make several experiments along this line in a well 8 inches in diameter by 800 feet deep, involving lifts in the well of from 13 to 30 feet, horizontal runs of 200 and 600 feet with a terminal lift of 50 feet. Standard air lift apparatus was used, which included an Ingersoll-Rand 10 and 10 1-4x12 Class "A" compressor, air receiver, and the usual piping, and the

derrick for obtaining the desired lift above surface.

As usual in all air lift experiments, the factors of submergence and velocity of flow figured largely, and a number of tests were made in the endeavor to locate the best points.

For example, in the 200 foot horizontal run it was found that a submergence of 40 per cent. required two and one-half times the volume of free air per gallon of water pumped, compared with 60 per cent. submergence, and in the 600 foot trial two and eight-tenths times as much air under same relative submergences.

Sixty per cent. submergence gives the best performance for a run of 607 feet, showing that to deliver a foot-gallon of water required .0111 cu. ft. of free air, and the best rate of discharge to be seven gallons water per minute per square inch area of discharge pipe.

The 207 foot horizontal, 60 per cent. submergence, took .0085 cubic foot per foot-gallon with 8.9 gallons water per minute per square inch area of discharge pipe.

Forty per cent. submergence, 200 feet horizontal run, gave .0197 cubic feet free air per foot-gallon as being required, and the best rate of discharge 4.2 gallons water per minute per square inch area of discharge pipe.

It is especially noticeable that increasing the volume of air supplied had little effect upon the quantity of water delivered, in fact serious losses follow any tendency to force the output.

The following tables have been prepared from the tests made, based on average results, and are considered to be safe and conservative:

Cubic feet of free air and gallons per minute per square inch area of discharge pipe for lifts of 13 to 30 feet at well, horizontal run of 200 feet, subsequent lift of 50 feet.

Submergence, per cent.	Cubic feet Free Air per ft. gal.	Gallons per minute per sq. in.
40	.0231	3
45	.0176	5.2
50	.0138	6.4
55	.011	7.6
60	.0094	9

Cubic feet of free air and gallons per minute per square inch area of discharge pipe for lifts of 13 to 30 feet at well, horizontal run of 600 feet, subsequent lift of 50 feet.

Submergence per cent.	Cubic feet Free Air per ft. gal.	Gallons per minute per sq. in.
40	.0352	3.6
45	.0264	5
50	.021	6
55	.016	7
60	.0127	8

Having these figures in view it may be profitable to make a single comparison of air lift vs. combined air lift and pneumatic displacement pump.

Disregarding the tables and referring again to the case of 60 per cent. submergence, 607 feet horizontal run, the factor at the best point is .0111 cubic feet per foot-gallon.

The water discharged being approximately 90 gallons per minute and the lift 78 feet, we have:

90 gallons by 78 feet by .0111 equals 78 cubic feet.

The working air pressure being 52 lbs. we may calculate the horsepower from the common tables in use and the result is 10.9 h. p.

Before proceeding, and in justice to the air lift system, it will be fair to note that if this were a straight lift of 78 feet the air required would have been 90 gallons by 78 feet by .0062 equals 43.6 cubic feet, representing 6 h. p.

Now taking up the combination of air lift and displacement pump to meet the actual conditions we have:

1st. A vertical lift of 28 feet for the air lift system.

2d. A horizontal run of 607 feet and a terminal lift of 50 feet for the displacement pump.

The free air required for the vertical lift of 28 feet with the air lift is:

90 gallons by 28 feet by .0122 equals 31 cubic feet.

The compressed air needed for the displacement pump is a volume equal to the amount of water displaced at a pressure due to the head. The 90 gallons of water to be pumped equals 12 cubic feet and the pressure required will be approximately 25 lbs., due to the head of 50 feet, plus friction. Reduced to free air,

$$12 \times \frac{25+15}{15} = 32 \text{ cu. ft.}$$

Ten per cent. should be added for clearance and other losses, making 35 cubic feet. Adding the figures for the air lift 31 cubic feet and displacement pump 35 cubic feet, we have a total of 66 cubic feet at 25 lbs. pressure, representing 5.6 h. p.

As the horse power required for this work under the air lift system alone was found to be 10.9 h. p. and for the air lift and displacement pump 5.6 h. p., there is a saving of 5.3 h. p. in favor of the latter arrangement under the stated conditions. from which we must conclude that good practice will favor the combination wherever it is feasible to employ it.—*Compressed Air.*

Water Problems Concerning Fire Protection in Cities.*

BY S. H. LOCKETT, C. E., NEW YORK CITY.

The primary object of water works systems was to furnish water for domestic consumption. Little attention was originally paid to the question of water supply for fire uses. In fact, far too little attention is paid to it now. The first works in this country for the supply of water to towns were those of Boston, built in 1632. These served to bring water by gravity from springs. Wooden pipes were used in early works, the first use of iron pipes being in Philadelphia in 1904.

The principal development in this country has taken place during the last fifty or sixty years. It has been very marked and due largely to the perfection of cast iron pipe and the improvements in pumping machinery, the manufacture of smaller pumps on a commercial scale, the adoption of the direct pumping system for smaller towns and the development of ground and artesian water supplies. Rapid, however, as the developments have been, they have not kept pace with the growth of our communities.

Most American cities find themselves today with undersized water works. It would seem off hand as though our engineers had been lacking in foresight, but such is not the case. Cost is always a governing factor in any undertaking, and our cities, small only a few years ago, could not then afford more comprehensive undertakings. Engineers, also, while creators in one sense, must base their projects largely upon the past achievements of their profession. None could anticipate the unprecedented development of our country. Villages and towns have blossomed into metropolises in a few years. The result has been that systems designed comprehensively upon the basis of growth in other countries have become obsolete long before their time. Supply works and distribution systems supposed to be ample for generations to come have been outgrown in a dozen or fifteen years. Fire protection engineering, therefore, has before it today serious problems, the solution of which is complicated by the habit the future has of dropping into the present in most American affairs. Let us examine some of them.

Of first consideration in any water works is the question of an ample reliable supply, whether it be for domestic or fire purposes. Except in small communities, fire protection concerns itself but little with gross supply alone. Only a very small percentage of the water used in any community goes toward fighting fires. In New York it is estimated that 1-15 of 1 per cent. suffices. The amount is, of course, negligible in the gross consumption of a city or town. Fire protection, however, is very much concerned with the amount and deliverability of water at certain times and in certain localities. In other words, it demands of a distribution system the ability not only to satisfy ordinary needs but to supply at effective pressures anywhere in the system water in addition for any fire likely to occur. The desirability of this double capacity is frequently overlooked.

It is a common thing to hear it stated that a given locality is well protected because the hydrants are on 8-inch or 10-inch mains, whereas these mains, fair enough if well supplied, may be poorly fed by inadequate arteries and subject to such a large normal domestic draft as to leave no margin of reserve for fire purposes at all. For example, New York, although outgrowing it, has an ample supply for its total present needs, but there is hardly any place on the island where its firemen can get water enough for third alarm fires owing to its faulty distribution system.

Where the gross supply is ample, there are three general ways of providing a full supply anywhere in a distribution system. One is by increasing the pressure sufficiently to overcome all faults of design in the distribution system; one by increasing the size of the pipes; and the third, by combining both methods. A decision as to which method to use rests upon many matters of expediency and expense. In many cases, especially with smaller systems, an increase of pressure is the simplest and may be accomplished with comparative ease where a direct pumping system is used. If a material increase is necessary, however, the possible damage to plumbing and weak mains becomes a serious factor in the problem. It not infrequently happens that an increase of only a few pounds causes serious injury to taps, flush-tanks, boilers, connections and even mains where these are old and worn. Recalking may prove to be necessary, also. Again, the increase of pressure alone means that all water must be pumped at a greater expense, and perhaps new pumping engines and boilers and housing for them will be necessary as well. In fact, operating and installation expenses will be materially augmented all along the line.

On the other hand, if an effort be made to secure results by enlarging the mains alone, this involves a great initial first cost upon which the interest also must be

*From a paper read at Yale University in the insurance course.

taken into consideration. When completed, the advantages of higher pressure may not obtain.

The situation in most cities is such that an effective compromise between increased pressure and large mains will be the economic solution of the problem.

The question of pressure is an important one. Pressures adequate for fire-fighting purposes without the intervention of engines are undesirable for domestic purposes, as may have been gathered inferentially from the remarks made as to the first methods of securing adequate deliverable quantities. It will be found that pressures ranging from 50 to 90 pounds are ample for domestic needs and for use in connection with private fire appliances, depending upon the city. In corresponding cities, such pressures are inadequate for the direct use of hose streams which are and will be for many years to come the main public reliance in extinguishing fires.

Owing principally to friction loss in hose and the necessity for delivering penetrating streams, pressures exceeding those mentioned are essential in present public fire-fighting methods in which the pressures named are needed at the nozzle instead of at the main. Adequate main pressures, even in new systems, for such fire service would involve unnecessary cost in every department. Plumbing would have to be of a special and expensive design, mains would need securer leading and calking and so on. It is of prime importance, therefore, that each community weigh carefully all the governing conditions before determining the pressure at which it will demand that water be supplied in its distribution system. In fact, the actual work of designing and elaborating a system along these lines is essentially the duty of the city, although it is equally the duty of the fire protection engineer to call attention to defects and suggest remedies, and in order to do so without bringing the profession into disrepute, his tentative suggestions must bear evidence of wisdom.

Requisite pressures are furnished by water systems in two general ways, by the domestic mains or by separate fire mains. Each, of course, is supplied variously. Domestic mains are supplied by gravity from reservoirs, lakes or other elevated bodies of water, or by direct pumping, in which case the source may be a lake, a river, a reservoir, ground water, artesian wells, etc. Combination systems may also obtain.

Separate fire main systems may be differentiated into two general classes, those having their source of supply always attached and those supplied by fire boats. Either may be wet or dry. Wet systems are those having their pipes full regularly and may be under a nominal pressure sufficient to keep them full or under working pressure. Dry systems have their pipes empty until needed.

The subject of separate fire main systems is very interesting and much could be said on it. We have time, however, for only a few generalizations. It might be urged with some propriety that such systems could be differentiated in another way into two general classes, those provided with adequate pressures and those not. Pressure is again important. If the system is intended for the direct use of hose streams, without the intervention of fire engines, it should be able to maintain under draft 200 pounds at the hydrant. It may be seen from this that many so-called high pressure systems are misnamed.

There is really only one full-fledged high pressure separate fire main system in this country. It is in Philadelphia, and, through poor design, it is far from being the success it ought to be. Systems such as those at Providence and Newark, supplied by gravity at about 140 pounds static pressure, are not capable of maintaining near this pressure under draft, and should not be expected to do first-class service with hose direct. Systems like those at Buffalo and Detroit, consisting of dry-pipe lines to be supplied by fire-boats, are also not deserving of full recognition. Fire-boats themselves are too often away from their moorings to be reliable as sources of supply, although as emergency supplies they are of some value. They are very much overestimated, however. Actual tests of many in service show their capacity to be much less than their rated capacity, and they do not as a rule operate at pressures sufficient for good hose streams.

A separate fire main system, to receive full recognition, should have minor distributers of 12-inch pipe, with arterial feeders or circulating mains in addition so proportioned as to supply the calculated draft at any spot in the system with a pressure of 200 pounds at the hydrant. It should also have one or more fixed pumping stations, each secure from fire. Other details would depend upon circumstances, but, if possible, it should be operated with fresh water and have a ready and reliable alarm system to be used in connection with it. A higher development still would be to have the system supply standpipes on the outside of each building.

Another important feature of any distribution system is the gate valve. Underwriters generally and frequently en-

gineers have paid too little attention to gate valves. They are often so badly spaced that a break will throw out of service thousands of feet of mains, together with the service connections and street hydrants. Such an accident coincident with a bad fire may prove costly; and bad fires are apt to coincide with a break of this sort which is a condition precedent to bad fires in many cases rather than a mere concurrence of events.

The location of gate valves is frequently unknown. Some of our largest cities are dependent upon the memory of an employe, whose job itself is dependent upon his memory, for knowledge as to the location of valves. In small localities, this is bad enough, but it is seriously objectionable in large distribution systems where breaks and the time lost in shutting off valves run rapidly into money for water and incidental damage and perhaps into more money in case of fire. It recently took six hours and fifteen minutes to locate and shut off a break in a 48-inch main in New York City.

Every community should have properly indexed records of the size and location of every gate controlling mains. It should also have a force of men skilled in the handling of these valves; and when a gate is opened or closed a record should be made of the fact and the fire department notified promptly by telephone and in writing. Investigation in a prominent city revealed the fact that a valve in a 24-inch arterial feeder had been closed and the stem broken for several years and no one the wiser. Neglect accounts also for the continued existence of bent stems, corrosion, rusting, broken gears, leaky valves, frozen parts, etc. Conditions of this kind could not obtain if a proper system of gate inspection and repairs were maintained, as it should be in any well organized works. While no fixed rule can be adopted as to the spacing of valves, it may be taken as a guide that in closely built sections valves should be so spaced that no more than 500 feet of mains will be cut out of service by a single break or other accident, and in residence districts not more than 800 feet. It is needless to say that all valves should open in the same direction, which is not the case in far too many cities.

As the immediate outlets for the distribution system, hydrants are very significant to the fire protection engineer. We are too often content with anachronistic makeshifts. The general run of hydrants have small barrels, ill-designed waterways, small connections to mains, lack individual gates for their outlets, open to the right and left indiscriminately, are usable by the public and street sprinkling gangs, drain poorly, possess weak parts, etc., and are attached in many cases to too small mains. Time does not permit a discussion of these interesting details, but the remedy is indicated in naming the defect. A similar system of inspection and records should be maintained to that recommended in the case of gate valves.

Last but not least of the general topics for the consideration of the fire protection engineer in connection with water works is the question of maintenance. Under it come such matters as personnel, expenses, plans, records, consumption, waste, electrolysis, etc. It is only by careful study of these various features that we are enabled to make a satisfactory estimate of many matters, arrive at definite conclusions and offer intelligent recommendations. The personnel of many departments often accounts for mismanagement, poor design and worse execution. A study of the plans and records furnish positive knowledge not only as to these, but is essential to a working knowledge of a system. The matter of consumption and waste frequently contains the key to a costly situation. It is only by an examination of the conditions governing these that an intelligent and comprehensive plan for future development may be matured. The elimination of waste by the installation of meters and proper restrictive measures has often postponed for years costly extensions, enabling the municipality to undertake other needed reforms. The study of electrolytic conditions has avoided costly repairs and legal complications and prevented bad fire losses through interrupted service. These are only a few of the matters coming properly under the subject of maintenance, but they reveal the importance, undoubtedly, of its relation to fire protection.

CITY LIGHTING

Syracuse Lighting Rates—Cost of Electric Lighting—Quality of Washington Gas—Uniform Wiring Symbols.

Syracuse Lighting Rates Fixed by State Board.

The New York State Commission of Gas and Electricity announced its decision, September 6, granting the application for an order fixing the maximum price of gas in Syracuse at 95 cents a thousand cubic feet, beginning October 1. The price of electricity for street lighting is fixed at $68 a lamp; for commercial purposes at 9 cents a kilowatt hour for one year, beginning October 1; after that time the price is to be 8 cents.

Present lighting rates in Syracuse are: Arc street lamps, $85.77 1-2 a year; commercial incandescent, 12 cents a kilowatt, with 2 cents discount if paid before the 15th of the month; gas, $1 a thousand cubic feet.

Cost of Electric Lights in Large Cities.

An exhaustive report was submitted to Mayor Cutler, of Rochester, N. Y., recently, by City Engineer Fisher, rehearsing lighting conditions in a number of cities. About August 10 Mr. Fisher addressed a circular letter to about 40 cities, asking for the price and other details of their electric lighting. At the time of making his report he had received replies from nineten cities having arc lights. From these replies he received information as follows:

Duluth, Minn., cost per year, $54.50; Richmond, Va., $54.75 (6.6 amperes, alternating current); Buffalo, N. Y., $56.00 (lamps on overhead circuit; underground circuit ordered after March 2, 1907; when contract takes effect, $75.00 per annum); Rochester, $57.95 (overhead circuit); Montreal, Que., $60.00; Baltimore, Md., $67.49; Omaha, Neb., $75.00 (6.6 amperes); Milwaukee, Wis., $81 ($99 for lights on underground circuit); Toledo, Ohio, $83.00; Minneapolis, Minn., $84.00; Syracuse, $85.77 (contract expired); Worcester, Mass., $91.25; Troy, $94.90; Newark, N. J., $95.00; Providence, R. I., $98.01; Albany, $98.55; Philadelphia, Pa., $99.42; Lowell, Mass., $100.00; Peterson, N. J., $101.00; Boston, Mass., $122.27.

Of these cities the lowest is Duluth, at a price of $54.50 per lamp a year. It is seen that there are only three cities out of the nineteen, Duluth, Richmond and Buffalo, which have cheaper contracts than Rochester would have if the new bid were accepted, and the prices in those cities are but a little over $3 lower. Recent statistics, which Mr. Fisher obtained from miscellaneous sources, show that in 29 cities, having 100,000 inhabitants or over, the average cost of lights, similar to those used in this city, is $86.18.

Two municipal plants, those in Chicago and Detroit, receive especial attention at the hands of the city engineer. In the former city the actual cost, exclusive of interest, taxes and depreciation, is $56.23 per lamp a year. Making a suitable allowance for the omitted items, the total cost is seen to be considerably more than the new bid in this city, according to Mr. Fisher.

Considerable comment on the possibilities of municipal ownership had been occasioned by the low price listed in Detroit, $34.99 a year. This is shown to be but a part of the consideration, however, the report treating the situation in Detroit as follows:

The city of Detroit, with a population, by the census of 1900, of 285,704, has had in operation a municipal electric light plant for about ten years. The city operated during the fiscal year ending June 30, 1905, an average of 2,812 arc lamps, 287 of which were located in the underground district. Eighteen hundred and twenty-eight (1,828) of these lamps were series alternating enclosed arc lamps. The balance of the lamps were open arcs, and, excepting the 287, were on overhead lines. The total number of hours the lamps were in use during the year was 3,774, an average of ten hours and twenty-one minutes. (The average in this city is eleven hours). The cash cost for operating disbursements for the year is given in the annual report of the public lighting commission at $34.99; depreciation on discarded machinery, $4.56; depreciation at 3 per cent. on the investment, $7.78; interest at 4 per cent. on the investment, $9.50; loss on taxes on investment, $2.51; making a total gross cost per light of $59.34.

The proposed municipal plant for New York city is also discussed, and it is shown that the projected annual cost per arc light was estimated at $64.07, exclusive of the cost of underground service.

Uniform Symbols for Electric Wiring Plans.

The National Electrical Contractors' Association has adopted a system of uniform symbols for wiring plants. The method of determining these symbols is described in the following committee report:

Your committee, desiring to obtain an expression as to the advisability of establishing a uniform set of symbols and the best and most feasible methods of having the same universally used, addressd letters to the leading engineers, architects, universities, various departments of the government and technical press. The replies to these letters were unanimously in favor of establishing uniform symbols, and the writers tendered their assistance and co-operation in the movement, and offered for the use of the committee the symbols in use in their various offices.

The committee was much gratified at the many expressions of approval of the plan and the appreciation of the effort of our organization in taking the initiative in this important work of standardization. The committee made a careful study of all the letters and systems submitted to them, desiring to develop a set of symbols that would conform as closely as possible to the different ones now in use. They selected from the many valuable suggestions those which appeared the simplest in form and the easiest of execution, and added to them such others as seemed necessary to make the system complete, comprehensive and serviceable.

Each and every symbol has been given careful study, and while the committee appreciates that the subject gives ample opportunity for many individual ideas, they believe that considered as a whole the symbols submitted herewith will be found to cover all the conditions and requirements of complete wiring plans.

We recommend that a committee of three be appointed by the president to place the set of symbols prominently before those making wiring plans and obtain their universal use. We further recommend that this committee be instructed to select at least twenty members from different parts of the country to personally interview architects and engineers in their localities with a view of securing their use of these symbols. We urge that each and every member exert his best effort to obtain the universal use of these symbols to the end that they may become a recognized standard.

Copies of the sheet containing the symbols and their explanation can be obtained of the secretary of the National Electrical Contractors' Association, Utica, N. Y.

Quality of Gas in Washington.

The report of Elmer G. Runyan, inspector of gas and meters for the District of Columbia, for the year ending June 30, 1906, says all records in the testing of gas meters were broken. The report shows that 6,995 meters have been inspected and proved during that period. Under the law the office is required to collect a fee of 50 cents for each new or complaint meter examined, and 20 cents for each repaired meter, and the total amount collected on this account was $2,740.70. Regarding the photometric testing of gas supplied by the Washington Gas Light Company, the inspector stated that 882 such examinations were made at the three testing stations during the year, and that the gas gave an average illuminating power of 23.22 candles, or 1.22 candles above the legal requirement. The highest power observed during the 12 months was 27.19 candles, at the southeast Washington station, December 21, 1905. The lowest was 19.08 candles, at the central station, Tenth and D streets northwest, on February 3, 1906. At no time during the year did the inspector find the gas to contain more than the legal limit of such impurities as ammonia and sulphur. Owing to the general and increasing application of gas in heating and cooking in recent years, the laboratory of the gas inspection office was equipped last year with apparatus for testing the calorific value, or heating power, of the gas. Extensive improvements were made during the year by both the Georgetown Gas Light Co. and the Washington Gas Light Co. in order to meet the growing demands upon their services.

Municipal Playgrounds in London.

The County Council of London, England, has decided to permit the playing of organized games, under responsible supervision, in school playgrounds, between the hours of 7 and 8 p. m. during April and September, and 7 and 9 during the intervening months. Similar privileges will be granted during the winter months.

ROADS AND STREETS

Steel Faced Curb—Chicago Street Railway Ownership—Washington Asphalt Pavements—Seattle Municipal Railway Vote—Clay Roads—Strength of Treated Timber—Dust Elimination in England.

Steel-Faced Curb for New York City.

In a decision rendered by Justice Dickey, September 8, he denied the motion for an injunction brought by John Murphy in a taxpayers' action, to restrain Joseph Bermel, president of the Borough of Queens, from awarding a contract for paving Metropolitan avenue with iron slag brick, from Dry Harbor road to Fulton street, in the village of Jamaica, a distance of about two miles. Justice Dickey holds that the concrete curb with steel facing along the upper outside edge, called for in the specifications, is not a patented article, as was alleged by Mr. Murphy in his complaint, and that any one can bid on the job and carry out the contract without buying any patented goods.

Mueller Law Constitutional and Municipal Street Railways Possible in Chicago.

A decision upon the constitutionality of the Mueller law, under which the advocates of municipal ownership of the street railways believe the city can purchase the different companies, was rendered by Judge Windes, of Chicago, September 15. He declared that the point raised by the opponents of the bill, in declaring that the law enables the city to take private franchises without due process of law, is not well taken.

The decision was a sweeping victory for the city on every important point raised in the Mueller certificate test case. Judge Windes holds that the Mueller act is constitutional and valid, and that the $75,000,000 ordinance properly carries out the act.

Judge Windes held:

1. It is not against public policy for cities to own or operate street railways.
2. The Mueller law is constitutional and not in conflict with the cities and villages act.
3. The title of the act is not defective and the act is not special legislation.
4. Neither the state nor the city becomes financially obligated or extends its credit under the law.
5. The $75,000,000 ordinance is in compliance with the Mueller law.

The case was heard in the vacation season for the purpose of obtaining a decision that would permit an appeal to the Illinois supreme court at the October term.

Asphalt Pavements in Washington.

A member of the street department of the District of Columbia, in an interview with a reporter of the Washington *Star*, September 8, said:

Although this city is the home of the asphalt pavement, and the last appropriation bill carried with it an item of $70,000 for new asphalt streets in the District, the peculiar fact remains that there are no bids on the part of contractors for a job which would look like a lucrative one to an outsider.

This presents an anomalous situation here, and it is one which may cause the city fathers considerable embarrassment. It is desired to begin the laying of the new pavement without unnecessary delay, but if the contractors will not bid the work can not be commenced. A decade or so ago the contract price per square yard for new asphalt pavement in this city was about $2.25 to $2.50. Congress later reduced it to $1.85, and now the maximum allowance per yard under the act is fixed at $1.65. The contractors say they can not lay it at this figure, so there you are. One contractor offered to lay the asphalt at the statutory figure, but as he charged an additional sum for the gutters, his bid could not be considered.

Of course, if we can't get any bids we will have to put up the shutters figuratively on this improvement, though there is one loophole which may let us out, and that is that the act simply specifies that the new streets may be laid "in asphalt," and perhaps under this clause it may be determined to lay the new streets in asphalt blocks instead of in sheet asphalt, after the style in which a great many streets on Capitol Hill are paved. This will be later considered.

Though we are blocked for the present upon the new asphalt street proposition, we are going ahead on other street im-

provements in a very gratifying manner. We have $300,000 appropriated this year, or $100,000 more than last year, and we will need every cent of it. In fact, the street problem in this city is becoming acute. Our streets are wearing out very rapidly. If we are to maintain our reputation for being the best paved city in this country, a lot of money will have to be forthcoming for this purpose under the next appropriation bill, and it is just as well that our citizens should clearly understand the matter.

Out of the 2,200,000 square yards of asphalt pavement laid in this city during the past thirty-three years, 800,000 square yards of it are over eighteen years old. The largest areas of asphalt pavements were laid from thirteen to sixteen years ago. Much of this large area is almost worn out, and though some of it has already been resurfaced much of it during the next few years will require complete renewal, and all of it will require increased attention by patching. We have not been able to properly resurface the streets of this city on account of lack of funds for that purpose.

You see, with the great increase of mileage surface in new streets and the old surfaces wearing out, we have two hard problems to meet on limited appropriations. There are two great classes of asphalt streets in Washington—the old coal tar, homogeneous kind, which was first laid, and the new with hydraulic cement base. When we strike these old streets for resurfacing purposes we have to tear them all up, practically making a new street of it in readjusting the crowns and the grades. Then we have to replace the old curbing with new stone. The resurfacing of this class of streets is an expensive job. With the new cement base we are enabled to peel off the worn-out asphalt surface and lay a new one at less cost.

Then we put down new gutters, and we make a fine piece of work in this class of resurfacing. But unfortunately we don't have enough money to adequately resurface, and this is the reason you will see so many of our patching gangs at work on the old surfaced streets patching them up as best we can to make them last, but, like the old woman's shoe, won't last forever patched.

Observing citizens interested in civic improvements have no doubt noticed the many instances of resurfacing now going on in various parts of town, and we are making the additional money go as far as it can, and are distributing it as equitably as possible. Last year we spent $74,000 in street repairs, $15,000 in new gutters and $4,000 in new curbs, and made a good showing, but this year we will do much better.

There is one fact about asphalt streets which is not generally understood and which is misleading, and that is the question of mileage. It is my understanding that Buffalo, N. Y., has claimed that that city has more mileage of asphalt streets than Washington, and we often receive letters from at home and abroad inquiring as to the asphalt mileage in this city. It is the area of square yards and not mileage that counts, and it is the only comparative test.

Thus the total square yard area of asphalt and coal tar streets in this city is, in round numbers, 2,744,000, or 136 miles; of asphalt block, 528,000 square yards, or 25 miles, and 487,000 square yards of granite pavement, or 26 miles. A single illustration will be found interesting, as Washington is the queen of cities when it comes to her asphalt streets. Pennsylvania street is 90 feet wide from curb to curb, or twice the surface in pavement of the average wide avenue in many cities. Our wider avenues, such as Massachusetts avenue, are 160 feet wide from building lines, or 50 feet from curb to curb, while the side streets will range from 32 to 35 and 40 feet from curb to curb. The principal railroad streets are about 50 feet from curb to curb.

When it is considered that a 30-foot roadway is considered a good width in many cities, some idea of what we have in this city in the way of asphalt surfaces will the better be understood.

We often receive letters from our citizens asking for the character and extent of our street pavements by the different city sections, and here is a brief epitome which I have prepared for the *Star* which will be found of value to citizens and non-residents alike:

Northwest—Asphalt pavements, square yards, 1,769,000; miles, 81; asphalt blocks, square yards, 28,000, about two miles. Northeast—Asphalt, square yards, 250,000; miles, 13; asphalt blocks, square yards, 184,000, about seven and a half miles. Southeast—Asphalt, square yards, 140,000, about eight and a half miles; asphalt blocks, square yards, 207,000; miles, 10. Southwest—Asphalt, square yards, 157,000; miles, 9; asphalt blocks, square yards, 50,000, about 2 1-2 miles. Georgetown—Asphalt, square yards, 128,000; miles, 9; asphalt blocks, square yards, 14,000, about three-quarters of a mile. Suburban, including Mount Pleasant and Columbia Heights—Asphalt, square yards, 300,000, about 11 miles; asphalt blocks, square yards, 43,000, about 2 1-2 miles.

There are still about ten miles of cobblestone pavements left in the city. We have about 11 miles of macadam pavements in the city proper and about 63 miles in the suburban districts. There are about 43 miles of gravel and unimproved streets in the city and about 121 miles in the suburbs. There are 7,395,000 square yards of streets in the District, or about 439 miles. This means that our street maintenance and repair cost is very heavy, and if these improvements are to keep up with the rapid growth of the city we will require a substantial advance in future appropriations for this purpose.

Municipal Street Railways in Seattle Voted Down.

At a special election held at Seattle, Wash., September 12, municipal ownership of street railways, as represented in a proposal to bond the city of Seattle in the sum of $4,272,000, of which $1,172,000 was to be charged against the general fund of the city and the remainder to be an indebtedness against 20 per cent. of the gross receipts of the system when in operation, was defeated.

Clay Roads in the South.

William L. Spoon, road expert in the office of public roads, says that "throughout the states of Virginia, North Carolina, South Carolina and other states in the South there abounds an unlimited supply of the very best roadmaking clay from which roads may be made at a much more reduced cost than if made of macadam. The mixing of sand and clay as a form of road construction has received careful study where in many sections they are the only materials for road building.

It may be safely said that the construction of sand-clay roads in the southern states has passed the experimental stage. It has ben proved that they are well adapted to light traffic, and are less noisy, less dusty, and are more resilient than the average macadam and they are well adapted to light traffic; they have proved to a great extent satisfactory. There are sand-clay roads in the South Atlantic and Gulf states over which heavy loads of cotton and other farm products are hauled throughout the year, with but little resulting damage. When the cheapness of this kind of construction is considered it will be seen that for certain localities, at least, it is preferable to macadam.

The price of labor, the price of the haul, width of roadway, and depth and nature of material enter largely into the cost of the sand-clay road. It is assumed, however, that if the clay is found within one mile of the road, the labor worth $1 per day and teams $3 per day, the cost of constructing a twelve-foot sand-clay road would be approximately $579 per mile. Where, however, the work is done by convict labor and the teams are owned by the counties working them, the relative cost per mile will be found considerably less.

Mr. Spoon's experience in sand-clay road construction in the South shows that the cost ranges from $200 to $1,200 per mile, and in most cases from $300 to $800 per mile.

Experiments have also been in progress recently to determine what could be done to better burnt-clay roads by burning or clinkering them. In some parts of the South, where these clay roads prevail, travel during the winter months is almost impossible. Mr. Spoon believes that burning will solve the problem, and that, within a few years, the sticky, miry, clay road will be a thing of the past.

Experiments on the Strength of Treated Timber.

The U. S. Department of Agriculture, Forest Service, has published Circular No. 39, which is a report by Prof. W. K. Hatt, of Purdue University, regarding his experiments upon the strength of timber which has ben treated by preservative methods. The following statements of results are abstracted from the paper.

A variation of 6 per cent. is found in the tests on samples from the same set of timbers, this difference masking to this extent the effects of the treating process.

The comments relative to the action of the cylinder processes on green wood may be summarized as follows:

(1) The steam at pressures up to 40 pounds applied for 4 hours or at a pressure of 20 pounds up to 20 hours increases the weight of the ties. At 40 pounds pressure applied for 4 hours and at 20 pounds for 5 hours the wood began to be scorched.

(2) The steamed and saturated wood when tested exhibited weakness in proportion to the pressure and duration of steaming. If allowed to air-dry, subsequently the specimens regained the greater part of their strength, provided the pressure and duration had not exceded those cited under (1). Subsequent immersion in water of the steamed and dried specimens showed that they were weaker than natural wood similarly dried and resoaked.

(3) The Burnettized wood was not

weaker under static loading than steamed wood, but was weaker under impact.

(4) The pressure of creosote of itself did not affect the strength of the wood. It affected only the rate of seasoning.

The following observations may be made with reference to the action of the cylinder processes on seasoned loblolly pine ties:

(1) The steam, at pressures up to 50 pounds for 4 hours and at 20 pounds up to 10 hours, increased the weight of the ties; at 30 pounds for 4 hours or 20 pounds for 6 hours the wood began to be scorched.

(2) When tested after subsequent seasoning the ties which had been steamed at and above these pressures showed a decided loss of strength.

(3) The Burnettized ties and creosoted ties were weaker than the natural wood and weaker than the steamed wood which had been seasoning for the same length of time. They had not, however, seasoned as rapidly.

Loblolly pine ties creosoted without steaming showed

(1) That the process of itself does not weaken the wood.

(2) That since no steam was used, a degree of seasoning resulted which had the effect of making the wood stronger.

(3) That the increase is not due to the particular treatment given, but could be effected by other non-steaming processes or by air seasoning.

The results of the tests form a body of evidence from which the following general conclusions may be drawn:

(1) A high degree of steaming is injurious to wood. The degree of steaming at which pronounced harm results will depend upon the quality of the wood and its degree of seasoning, and upon the pressure (temperature) of steam and the duration of its application. For loblolly pine the limit of safety is certainly 30 pounds for 4 hours, or 20 pounds for 6 hours.

(2) The presence of zinc chlorid will not weaken wood under static loading, although the indications are that the wood becomes brittle under impact.

(3) The presence of creosote will not weaken wood of itself. Since apparently it is present only in the openings of the cells, and does not get into the cell walls, its action can only be to retard the seasoning of the wood.

Dust Prevention Experiments in Surrey.

A REPORT BY FRANK G. HOWELL, COUNTY SURVEYOR OF SURREY, ENGLAND.

In May, 1905, the committee reported to the county council as follows:

The committee have for some time past had under their consideration the question of dealing with the nuisance arising from dust raised by the motor traffic, and the consequent mischief done to the highways. Several experiments have been made in the county with various materials with a view to minimizing or preventing this, and the committee have watched the effect thereof with much interest. They have also obtained information from various parts of England, but this is of a very conflicting nature. The committee consider that the time has arrived when the council may themselves make some experiments in connection with what is a pressing and a difficult problem. It is hoped that a material may eventually be found, the cost of which, spread over a few years, may not greatly increase the cost of maintaining the roads, while dealing with the evil complained of. With a view to obtaining practical and reliable information as to the value of various materials and the system of using them, they recommend that they be authorized to expend sums not exceeding $10,000 in laying dust-preventing materials on sections of the main roads.

Some difficulty was found in choosing suitable lengths to be treated, as for some experiments it was necessary for the sake of economy to select lengths which were in need of repair, preference being given to those in positions easily accessible for observation. Eventually it was decided that experiments should be tried in the Barnes urban district, Croydon rural district, Epsom rural district, Esher and Dittons urban district, Farnham urban district, Frimley urban district, Godstone rural district, Hambledon rural district, Reigate rural district, and Surbiton urban district.

Mr. Howell divides the experiments into four classes:

(1) Tar-Macadam in Place of Existing Metal.—This, as used at Surbiton and Barnes, is a process of excavating and removing the existing metal on the surface of the road, and coating the road with either limestone or slag, dried, heated, mixed with tar and laid and rolled, and finished with a thin layer of a somewhat similar material of a smaller gauge. This process costs about $1 per yard super.

(2) Tar Macadam Laid on Existing Metal.—In this process the existing material is not removed, the surface being scored and the tarred metal merely spread and rolled. The cost varies, according to thickness, from 37 to 75 cents a yard super.

(3) Tarred Surfaces, or Painting the

Road with Tar.—The road when perfectly dry is thoroughly swept until the granite or flint is exposed. Hot tar is then poured on to the road and brushed well into it, the surface being sprinkled over with sand.

(4) Treating the Road with "Akonia" or with a Solution of Calcium Chloride.—In this case a proportion of the salt is mixed with water. The surface is sprinkled upon two consecutive days from an ordinary water cart, and afterwards at intervals as may be required.

Taking each district separately, says Mr. Howell, the results of the experiments have been as follows:

Barnes Urban District.—An area of 4,500 super. yards in High street, Mortlake, laid with "Tar-Mac." The cost worked out at $1.05 per yard super. When finished the road presented a hard surface of a character similar to asphalte. In September last I reported that the surface was in a first-rate condition, and that the material seemed to be standing the heavy traffic in a satisfactory manner. The length has been constantly inspected since, and it is not now wearing well. Many portions of the surface have had to be patched and repaired; the length requires quite as much scavenging as ordinary macadam, and unless frequently watered it is by no means dustless.

Croydon Rural District.—A length of between 500 and 600 yards of "Tar-Mac" was laid on the Surrey and Sussex main road, Mitcham, at a cost of 58 cents per square yard. The length adjoins the section of road which was coated with tar-macadam in 1904, and which proved satisfactory. The surface of the new length stands the traffic well, and it is estimated by the district surveyor that half the ordinary amount of watering is sufficient for laying the dust.

Epsom Rural District.—A length of road at Cobham was painted with tar, and on the whole the result was successful. The road is open and wind-swept, and the wear and dust were considerably reduced. Tracks worn by motor car wheels were not so apparent upon this length as they were on the untreated lengths at either end of it. There were complaints when the tar was freshly laid, and during the first heavy rains of the winter, but many people living near the road asked for the treatment to be renewed this spring. The cost of the tar-
square yard.
ring works out at about 3 cents per

Esher and the Dittons Urban District.—A considerable portion of the road in this district was watered with "Akonia." This material certainly lessens the dust nuisance to a great extent. The cost is from $200 to $250 per mile per annum.

Farnham Urban District.—A length of tar-macadam was laid in West street, containing 800 yards super, at a cost of $600, or at the rate of 75 cents per yard super. The whole of the remainder of the main roads through the town were treated by a process consisting of tarring the surface and sprinkling occasionally with a mineral oil. The total area of the surface treated with this process was 10,500 super yards. The tar cost $150, labor $190, grit and lime $30, pitch, oil and use of tools $35, and the subsequent dressing with oil an additional $140, or a total of $545, being at the rate of 5 cents per yard super. The section coated with tar-macadam is not satisfactory. The wear of the surface which has been tarred has, in my opinion, been considerably lessened, and I should judge that the cost of this portion of the experiment has been saved by the reduced expenditure upon maintenance. Complaints were received during the winter months, but the urban district council were so well satisfied with the success of the tar and oil treatment that the county council were requested to allow the roads to be again treated this year. It is claimed that the process stops the dust to a great extent, and whenever I have inspected the roads there was little dust to be seen.

Frimley Urban District.—In this district the surface of the London road, Camberley, or High street, Frimley, were painted with hot tar containing about 10 per cent. of pitch, the tarred surface being afterwards sprinkled with limestone chippings and rolled. The superficial area treated was 7,258 yards, and the cost was 5 cents per yard super. The district council were pleased with the experiment, but when I inspected the roads there was a considerable amount of dust upon the tarred lengths.

Godstone Rural District.—The main road at Whyteleafe, for a length of about 700 yards, was treated with "Tar-Mac" in August last. The weather was very unfavorable when the "Tar-Mac" was laid, and soon after the work was done a number of cross trenches had to be cut in connection with the water supply, the new surface being very much damaged. When I have inspected the road I have found the experimental length with dust upon it, probably arising from the cross-roads and the gravel footpaths. About 300 tons of "Tar-Mac" at $4.50 per ton, were put on the road, and the total cost, including spreading and rolling, works out at about 50 cents per square yard.

Guildford Rural District.—In the vil-

lage of Ripley an area of 660 yards super. has been repaired with tar-macadam, at a cost of 30 cents per square yard. and the rest of the road through the village dressed with tar, at a cost of about 3 cents per square yard. These experiments were made much later than the others, in consequence of the work having been stopped by the weather. The dust nuisance is said to be materially reduced, but it is at present too early to judge of the success or failure of the experiments.

Hambledon Rural District.—A section of the main road, 360 yards in length, by Cranleigh station, containing an area of 2,160 square yards, was coated with tar-macadam. The materials used consisted of 161 tons of coarse tar-macadam and about 70 tons of similar material, but of a medium and finer gauge. The cost works out at 26 cents per yard super. This length has not worn well. The material was laid over half the width of the road at a time, and the joint in the center is unsatisfactory. When I inspected the road it was not in good condition, and almost as dirty as the adjoining lengths. At Milford, also in this district, an area of 2,400 super. yards of the main road was coated in July last with tar-macadam, at a cost of 54 cents per square yard. The materials used were 2 1-2-in. lime stone tar-macadam chippings. The experiment was successful as far as the surface is concerned. I have frequently inspected this section of road, and although it is not so dusty by any means as the road at either end of it, there is a considerable amount of dust on the length after a period of dry weather.

Reigate Rural District.—A length of road in the village of Merstham, containing an area of 1,142 yards super., was laid with "Tar-Mac" in September last, at a cost of 93 cents per yard super. The surface of the road appears to be wearing fairly well, but has had to be patched in several places, and the experiment was made so late in the year that there has not yet been an opportunity of seeing the effect of a summer's traffic upon the road. The length of road treated, viz.: about 150 yards, was also too short to test the dust-preventing properties of the material, as the dust from the ordinary macadam at either end is carried and blown on to the treated length.

Surbiton Urban District.—A length of 700 yards of the Portsmouth road, south of the boundary of the borough of Kingston, was laid with "Tar-Mac" at a cost of 95 cents per yard super. This was the largest experiment of all, and I am sorry to say the least satisfactory. The surface was laid by the "Tar-Mac" Company with too short a camber, and with a very irregular and uneven joint along the whole length of the crown. Many complaints have been received about this length. It has proved very slippery, and requires more attention and scavenging than ordinary macadam. It is also by no means dustless; in fact, after a shower of rain, when the sun is shining, I have sometimes seen it with dust flying when the macadam at either end was without dust.

Of the $10,000 voted by the county council, the sum of $9,093 has been paid to the district councils toward the cost of the experiments, but the total expenditure upon the work amounts to a larger sum, as the cost of the ordinary material intended to be used on the lengths treated, and included in the yearly schedules for the maintenance of the roads, has been included in the experimental work.

Besides the inspections I have made from time to time of the several experiments, says Mr. Howell, I have visited many of the experimental lengths which have been laid down in other counties near Surrey, and a great deal of information has been given me by the surveyors of the districts where experiments have been carried out. The success or comparative failure of all these processes depends to a great extent upon the weather experienced during the execution of the work. The results of various experiments of a similar character are often found to be quite different. A length of road tarred during exceptionally fine and dry weather may prove most successful, while another length where the work was interrupted by rains may cause many complaints and give much trouble before the surface will bind at all. It is still too early to speak with any certainty as to the cost of tar-macadam compared with that of ordinary macadam, as some years must elapse before the life of the tarred material can be ascertained, but I am of opinion that although this material is successful in some places where the traffic is light, it is quite unsuitable for the main roads in the county carrying the heavier traffic. Even upon the roads with light traffic the tar-macadam would have to last from eight to twelve years, without renewal to bring the cost down approximately to that of ordinary macadam, and I feel sure that any attempt to use it on an extensive scale must result in a very large increase in the cost of maintenance. Unless carefully cleansed when slightly wet the surface becomes slippery. It is not dustless, and the dust from it is, in my opinion, of a more objectionable character than the dust from an ordinary road.

With regard to the experiments in

painting the roads with tar the initial expense is small, and a considerable amount of dust is prevented. Upon wind-swept open roads the surface is preserved by the tar, and the cost of the tarring is practically saved. On granite roads near villages and towns the cost is not saved by the decreased wear, but the dust is lessened. The tarring can only be properly done during perfectly fine weather, and, unfortunately, however carefully the work is executed, the surface is liable to churn up during the heavy rains of the early winter, when the water seems to get under the tar and loosens the surface. At such times complaints are received of the inconvenience caused by the black mud, but it is usually found that the surface settles again after a few days of dry weather. I estimate that the tarred roads are upon the average in a bad condition for about fourteen days during the winter, but in spite of this disadvantage, in many places the inhabitants along the roads are anxious for a renewal of the tarring in the summer to mitigate the intolerable nuisance from the dust caused by motor cars.

The use of "Akonia" or calcium chloride, concludes Mr. Howell, does without doubt reduce the dust nuisance to a considerable extent. The material contains salt and attracts moisture, and is said to have a deleterious effect upon iron and tram lines. Some surveyors who have used it consider that it prejudicially affects the permanent binding qualities of the road metal. The cost of the material is high, and if used on many miles, the additional expenditure on the roads would be considerable. It appears to me that this class of material is more particularly suitable for use on special occasions, such as preparing roads for heavy traffic to race meetings in dry weather.

MUNICIPAL ACCOUNTING

Methods of Municipal Accounting of Receipts and Disbursements.

BY LOUIS BETZ, COMPTROLLER, ST. PAUL, MINN.

Proper methods of accounting breed a habit for economy and therefore proper methods of municipal accounting mean a great saving of money to the taxpayer, and in addition to good methods, publicity in municipal accounting is absolutely necessary for the existence of good government and is a check upon reckless extravagance, but the publishing of an annual report of the financial conditions and of the financial transactions of a city, is not always publicity, for many such reports are compiled in a way that is misleading to the average citizen who is looking for information. It therefore behooves all accounting officers to install as simple a method as possible for keeping the books of a city, and when publishing a report to bring out the various statements in a clear and concise way that the average citizen who may know little about accounting can understand. It is for this reason that in all methods of municipal accounting, the most important items to be considered are receipts and disbursements; these being accurately systematized one can easily extract for the purpose of tabulation, such amounts that represent revenue and expenditures and all other figures to be used for statistical purposes. I do not think the municipal books of account should in themselves be kept in a way that they may be used for statistical or comparable purposes; all these features must be embodied in the annual report, and the making up of an annual report is an entirely different work from that of keeping books of account. There is no question but every such report should have a statement showing the revenue and expenses as distinct from receipts and disbursements, but to keep the regular books of account in such a manner so they will always show the difference between the two, will in my mind lead to complications that may be difficult to straighten out, especially when we consider that in most cities comptrollers and auditors are elected by the people and a change in officers means a change in employes, and it is for this same reason that I am somewhat in doubt whether the so-called balance sheet, as introduced by our cities, will prove a success and an improvement on methods that are now in vogue. In these balance sheets, both on the debit and credit sides, items are introduced that are more or less estimates of revenue and expense, the figures of which must

*A paper before the National Association of Comptrollers and Accounting Officers.

be later changed by journal entries. They also claim to show the capital surplus and the current surplus, items which I am afraid will be misleading to the average citizen. The capital surplus is found by deducting the bonded indebtedness from the value of the corporate property, and the showing of such a surplus is claimed to affect the credit and borrowing power of a city, but the value of such property (except waterworks, lighting plant, etc.) is only imaginary so far as security for the creditor is concerned, for should it ever come about that bondholders would have to foreclose they would find that city depopulated and its public property valueless. The power to collect taxes from its citizens is the only asset upon which a city can borrow money, and by the same power it must pay off its indebtedness; therefore I do not believe that definite values of corporate property should be carried in the regular books of account, but the cost and value of such property should be kept in supplementary books and statistical reports. As to current surplus most charters and municipal codes designate the disposition of any funds that may be on hand in excess of departmental expenditures. There is no doubt but what the introduction of these new methods into municipal accounting by well known public and chartered accountants will ultimately lead to more improved, if not uniform, methods of accounting in all our large cities, but only experience will tell us in the end which method is the best. Personally, I believe our public accountants have spent too much time in trying to reconcile municipal with commercial accounting. Improved methods in the latter all lead to a clearer display of profits and losses of the business and at all times showing the amount of property on hand that can be quickly converted into cash. A municipality is a paternal corporation, collecting annually from its citizens certain sums of money and spending the same sums for the benefit of the community, so that municipal accounting must be more or less of a statistical nature, and therefore the paramount duty of all comptrollers and auditors is to install a perfect system of recording and classifying receipts and disbursements.

Many of our municipalities have several disbursing officers, as well as several boards clothed with the power of levying taxes, independent of each other; this is always a source of confusion and under such conditions it is almost impossible to have a good and proper method of accounting. Such cities should bend their energies to bring each of these branches of the government under one head; only when all funds of the municipality pass through one department can a clear and concise report of its financial standing be made, and in such event, all departments receiving money should make daily reports to the comptroller, and, as is in vogue in St. Paul, the comptroller should make out daily balance sheets showing the exact standing of every account on the ledger. In the matter of classifying receipts and disbursements and revenue and expenses in annual reports, great progress has been made in late years towards standardizing phrases and captions used in this connection, and for this we are greatly indebted to the census bureau at Washington, and especially to Mr. LeGrand Powers, its chief statistician. If this department is allowed to continue the work so ably and energetically undertaken along these lines, improved methods of accounting and uniform financial reports will result in the principal cities of our land, thus making it possible for cities to compare their expenditures in an intelligent way, bringing about a great saving of money to the taxpayers.

U. S. Civil Service Examinations.

Examinations will be held by the U. S. Civil Service Commission at the usual places as follows:

For engineer and carpenter in Indian service at Winnebago, Neb., at $660 a year, on Oct. 24, 1906. This is the third examination for this place, no eligibles having been secured at the former examinations.

For junior civil engineer in the Engineer Department at Large, at Manila, P. I., at $1,600 a year, on Oct. 24, 1906. This is under the War Department, not the Philippine service.

For the Philippine service, Oct. 17, for master builder at $2,750 a year; bridge engineer at $2,250 a year; principal assistant chief engineer, department of sewer and waterworks construction, Manila, at $4,000 a year; for assistant engineer, at $1,800 a year; for second assistant engineer, at $1,800 a year.

CEMENT AND CONCRETE

Testing Waterproofing of Cement—Concrete Culvert—Cement Importations—Wreck of Cement Cargo—English Cement Trade.

Methods of Testing Cement for Waterproofing Properties.*

BY W. PURVES TAYLOR.

With the continually increasing scope of uses to which cement mortars and concretes are put, occasions frequently arise in which it is desired to make the construction waterproof so that it may resist either water under head or dampness and hence be entirely dry on the unexposed surface. To meet this condition several methods of waterproofing have been devised, which may be roughly divided into three classes: (1) methods involving the use of bituminous compounds with or without the addition of paper or felt, the waterproofing substances being distinct and separate from the concrete; (2) surface washes applied to the surface of the hardened concrete, and (3) compounds added to the cement or concrete in mixing and hence forming an integral part of the concrete itself, it being with this last class that this paper is chiefly concerned. The many waterproofing compounds now in the market are so varied in character that it is extremely difficult to devise laboratory tests by means of which their suitability for construction may be determined, and furthermore it is most necessary that these compounds should be subjected to tests, for while some of them are based on sound principles and produce excellent results, others are so poor that placing them on the market is little short of arrant fraud.

It would appear that, to determine the resistance of a cement mortar to the action of water, the natural tests would be those of permeability and absorption, but unless the results of these tests be most carefully considered, misleading inferences are most likely to be drawn. Moreover, simple as these tests are, there is no standard method of performing them, so that results obtained in different laboratories are seldom comparable.

In the pursuance of the investigations of these compounds in connection with the work of your waterproofing committee the first method of testing permeability tried was that recommended by the French Commission on Standard Methods of Testing, which consisted of cementing a glass tube on the top of a cube of the cement mortar to be tested and then connecting this tube to a reservoir of water the height of which and hence the head of water acting in the tube being either 1-10, 1, or 10 meters, depending upon the peremability of the specimen. The writer was, however, unable to obtain results anything like comparable or uniform by this method, although a number of variations in the size of the specimens as well as in the size and position of the tube were tried, and in spite of the fact that the greatest care was exercised in the forming and manipulation of the specimen.

After these unsatisfactory trials, a form of apparatus was devised, which has given more satisfactory results than any form so far experimented with. The specimen used is in the form of a disc three inches in diameter and one inch thick, which is made in a mold of spring steel fastened with a clamp or screw. The apparatus is made from a 3 1-4 inch brass pipe having a ring 1-2 inch wide, fastened 1 inch from the end of the pipe. Rubber packing 3-16 inch thick is placed against this ring and also over the specimen, so that by tightening the outer nut the test piece is securely locked into position. The orifice in the outer nut is 2 inches in diameter, while the pressure is indicated by a gauge under which is a pet cock through which the air can escape and by means of which the pressure is exactly regulated. For test-pieces of 1:3 mortar, the pressure should be 10 pounds, while the number of cubic centimeters of water per minute passing through the specimen gives a measure of the permeability.

In making permeability tests it is especially important that the manipulation of the specimen be uniform, or otherwise most discordant results will follow, for it appears that permeability is more affected by small deviations of methods than probably any other test to which cement is subjected.

Especial care should be taken to see that the granulometric composition of the sand is kept uniform, and the mixing

*A paper before the American Society for Testing Materials.

and molding of the specimens should be performed with exceptional care. In the storage of the specimens there is no recognized standard practice although permeability is much affected thereby, storage in air increasing it, while storage in water decreases it, as the following example shows clearly, this test being made on a normal 1:3 Portland cement mortar, all tests on the same specimen:

Treatment.	Permeability. c. c. per minute.
7 days in water—14 days air	150
48 hours more in water	133
72 hours more in water	127
24 hours more in air	133
72 hours more in air	172
96 hours more in air	200
24 hours more in water	163
72 hours more in water	150

Another important factor affecting the results of the test is the time at which the reading is taken after the pressure has been applied to the specimen, the rate of permeability first increasing for from 20 minutes to an hour and then slowly decreasing. The pressure, of course, must always be the same in any series of tests, the rate of flow varying approximately with the square root of the head.

In the test of absorption, there is comparative uniformity in practice except in regard to the treatment prior to immersion in water, some drying the specimen in an oven and others testing it merely air dry, the tests made in the first manner, of course, giving much greater values. Both methods of testing have strong arguments in their favor, but it is thought that tests on air dry specimens represent better the conditions of practice and that their results indicate more nearly the true water resisting properties of the specimen.

Several other tests for waterproofing are occasionally made, such as forming small bowls of the mortar and floating them in water, recording the time at which they sink, this test giving a measure of both absorption and permeability, but unfortunately not being capable of giving precise results and hence unsuited for a standard test, although well adapted to showing the comparative merits of any two mortars. Another test is made by spraying one side of a specimen or block from a standard nozzle, measurement being made of the time required for dampness to permeate the face opposite the one on which the spray is applied, but such tests give practically no additional information when the absorption and permeability are known and are much less adaptable to standardization.

The following method has therefore been adopted tentatively as the standard for determining the water resisting properties of a cement mortar: Specimens are first made in accordance with standard practice in the shape of discs 1 inch in thickness and 3 inches in diameter, the mortar being made in the proportion of 1:3. The discs are kept in moist air 24 hours, then immersed in water six days and finally removed from the water and kept in dry air for 21 days more. At the end of this time (28 days from the time of making) they are weighed and placed in water for 48 hours, then weighed a second time and the percentage of absorption determined. The specimens are then immediately placed in the permeability machine before they have commenced to dry out, and subjected to 10 pounds water pressure, which is maintained for 10 minutes, and then the number of c. c. of water passing in a minute is measured, giving the value for permeability. A test should be based on the results from not less than five specimens, any results being discarded which are obviously in error. Of course when it is expected to use the mortar under unusual conditions, these conditions should also be duplicated as nearly as possible on additional test pieces, and tests made on specimens kept in acid or alkaline waters, in oil, in gas drip, and in other conditions will give most valuable information.

To show the character of results obtained by this method, a few preliminary series of tests will be cited, the first being on mixtures of Portland and natural cement, the results of which follow, all tests being made on 1:3 mortars:

Mixture.		Strength.				
Per cent. Portland.	Per cent. Natural.	7 days.	28 days.	4 months.	Absorption.	Permeability.
100	0	301	357	361	9.5	794
80	20	279	361	410	8.9	753
60	40	251	347	439	7.0	340
40	60	203	324	411	6.7	380
20	80	150	259	375	7.1	(500)
0	100	84	173	292	9.6	640

It will be observed that the absorption and permeability are both least when the mixture is about half and half, a result which might be expected. The high strength of these mixtures at four months presents also an interesting feature.

The following series shows a few tests made on mixtures of Portland cement and hydrated lime in 1:3 mixtures:

Mixture.		Strength.				
Per cent. Cement.	Per cent. Lime.	7 days.	23 days.	4 months.	Absorption.	Permeability.
100	0	301	357	361	9.5	794
95	5	260	351	373	6.7	735
90	10	274	305	282	6.4	715
85	15	281	315	267	6.4	470
80	20	289	315	260	6.4	430
67	33	243	250	245	7.3	220
50	50	146	206	217	7.8	10

Which shows the great value of the use of this material in decreasing permeability, while small additions have but little effect on the strength. The last values of absorption are apparently anomalous and may be due to error.

The value of the permeability tests was still better shown in the examination of cement mortars treated with various compounds, the results of which will be presented later in the report of the waterproofing committee.

In closing, I would state that the purpose of introducing a discussion on this subject was due to the great difficulty experienced by the committee in properly testing the various waterproofing compounds submitted for examination, and it was thought that an open discussion on these tests would not only be of interest to the members, but of help to the committee in the pursuance of their investigations.

Portland Cement Importations on Pacific Coast.

Prof. Clancey M. Lewis, of South Pasadena, Cal., has compiled the following statement of Portland cement importations on the Pacific coast for the past five years:

Year.	Port Townsend. Pounds.	Portland. Pounds.	San Francisco. Pounds.	Los Angeles. Pounds.	San Diego. Pounds.
1901	64,398,947	16,995,381	103,415,552	1,602,400	22,331,600
1902	43,504,817	43,269,807	163,122,186	17,771,600	24,760,800
1903	73,941,076	70,746,075	177,373,661	67,664,000	38,474,400
1904	109,385,285	68,874,792	78,759,439	38,906,800	13,744,400
1905	100,681,676	69,260,383	51,217,774	28,722,000	20,077,200
Year.	Values.	Values.	Values.	Values.	Values.
1901	$239,067.00	$65,687.00	$364,381.00	$5,299.00	.....
1902	159,134.00	158,141.00	551,319.00	67,481.00	.....
1903	245,315.00	249,570.00	577,624.00	233,804.00	.....
1904	372,067.00	220,166.00	261,526.00	146,895.00	.....
1905	361,663.00	218,981.00	165,336.00	109,439.00	.....

The following comparisons are made by him:

The importations at Port Townsend increased in proportion from 3-7 those at San Francisco in 1903 to double in 1905, partly on account of increase at Port Townsend, but mainly on account of the domestic cement made in the California mills, two of which put their material on the market in 1904. This domestic material reduced the importations in 1904 on the Pacific coast about 50 per cent. The differences in valuation of imports between 1903 and 1905 is over $500,000. This sum added to the increase in the use of cement in that period gives an idea of the amount of business picked up by the California plants.

Prices of imported cement averaged $1.382 per 400 pound barrel in 1903 and $1.524 in 1905, an increase of 14.2 cents, at the same time that there was a falling off in importations. The duty on cement is 8 cents a hundred pounds, nearly 32 cents per net barrel.

English Cement Trade.

Stagnation in the Portland cement trade in 1905 has given way to a decided improvement, both in Great Britain and the continent of Europe. Demand has fully overtaken production, prices have improved and are still tending upward, and manufacturers are accumulating unfilled orders. The San Francisco rebuilding needs created an unusual demand for cement, but before that there were unmistakable signs of recovery.

During the year 1905 the total shipments from the United Kingdom to the United States amounted to 11,150 tons, and in 1904 to 5,073 tons, while for the seven months ended July 31 last they had already reached the comparatively large total of 60,932 tons. The total British exports in 1905 amounted to 456,558 tons, while the exports for the first seven months of this year were 358,551 tons. The maximum annual production of Port-

land cement in Great Britain is estimated at about 3,000,000 tons.

Belgium exports annually considerably larger quantities of cement than Great Britain, the total for 1905 being 679,426, and for 1904, 448,295 metric tons.

Wreck of Vessel With Cargo of Cement.

An interesting echo of the San Francisco earthquake is found in a shipwreck that recently occurred near England. The ship Socoa, bound for San Francisco with a cargo of cement, for use in the rebuilding of the city, was wrecked off the Lizard, on the Cornwall coast. The ship struck a rock, which tore a large hole in her side, and remained fastened as upon a pivot.

When the salvage crew arrived to see about taking the Socoa from her perilous position, the men found a remarkable condition of affairs. The water had entered the hold, and its action upon the cargo had caused the cement to set. It had accommodatingly set hard around the rock that pierced the side of the ship, which now remains fastened there permanently in its unique position. The entire cargo has become as hard as stone, and nothing can be done with the ship except dismantle as much of the wood as can be removed. The hull will probably remain there for many years as a conspicuous advertisement for the cement manufacturers.

A Low Cost Concrete Culvert.*

BY W. H. WHORLEY, ASST. ENGR. N., C. AND ST. L. R. R.

In line with the policy of the Nashville, Chattanooga & St. Louis railway to fill all trestles instead of rebuilding them, whenever possible to construct culverts for the waterway required, it was decided at the beginning of the fiscal year to fill trestle No. 55.7 on the Nashville division. This trestle, which is known locally as Yellow Bank trestle, has a total length of 922 feet, with the track at an elevation of 76 feet above the valley. There is no stream under the trestle except during the wet season, when a large volume of water passes through the valley.

After making a survey of the drainage area above the trestle to determine the size of the waterway required, a 12-foot full centered concrete arch culvert with 6 foot side walls was decided upon as being ample, and plans were prepared for the same.

*A paper presented before the Engineering Association of the South, Jan. 13, 1906.

In designing the layout of the plant for building the culvert advantage was taken of the height of track above the valley, so that as nearly as possible all material moved by gravity from the cars in which it was shipped until finally placed in position in the wall. Slag and sand were shipped in drop-bottom cars and unloaded into bins constructed in the trestle. These bins were built with hopper bottoms ending in chutes that led to a wheeling platform, which occupied the space between two of the trestle bents and extended over a concrete mixer placed just outside of the trestle. The slag bin was equipped with two chutes and the sand bin with one, so that all material for one batch could be loaded at the same time. A cement house was erected alongside the trestle at the wheeling platform, level with and adjoining the platform. An inclined chute led from the opposite end of the cement house to an unloading platform at track level, so that the cement, which was shipped in sacks, could be handled directly from the cars to the chute, and thence by gravity into the house. The sand and slag were fed by gravity into wheelbarrows through gates controlled by levers to regulate the amount taken, and were then dumped into a hopper directly above the mixer. Two men wheeled slag to the mixer, one man wheeled sand, and one man wheeled cement. With the mixer in operation the wheeling platform became a busy place, as these men had to load the barrows and make a round trip, including dumping the load into the hopper in about one minute's time. The maximum wheeling distance from the chute to the hopper was 23 feet.

A water supply was secured by sinking a well in the drainage channel just below the trestle, the water from this being pumped by means of a gasoline engine into a tank placed on the trestle. From the tank a continuous stream of water was fed into the mixer through a flexible connection, a valve so regulating the flow that the necessary amount was delivered in the time required to mix a batch.

A drop-bottom car of 1 cubic yard capacity, running on 30-in. gauge tram tracks, conveyed all concrete from the mixer to the wall. The hinged bottom doors of this car were held closed with a latch, which was withdrawn by means of a lever at the side of the car to dump the load. After dumping, the bottom doors closed automatically, and were latched by the lever above referred to. A trestle spanning the entire culvert, with the deck at a sufficient height to clear the top of the arch when completed, was

constructed out of old car sills, and longitudinal tracks were built on the same directly above each wall, two small turntables connecting the longitudinal tracks with a cross track that extended to the mixer. This arrangement permitted handle the car, and they made the round trip when going to the extreme end of the culvert in about three minutes, the mixer in the meantime discharging into a small hopper, which discharged into the car upon its return.

TABLE I. STATEMENT OF COST OF CERTAIN CONCRETE STRUCTURES.

	16 ft.culv. No. 25.5, Nashville Division.	12 ft.culv. No. 133.3, Chattan'ga Division.	12 ft.culv. Doe Creek, McMinnville Br.	10 ft.culv. No. 1.0, P. & M. Division.	12 ft.culv. No. 55,7, Nashv'le Division.
Labor Costs:					
Cubic yards	986	292	406	354	1,217
Excavation	$639.05	131,15	140.50	212,20	345.52
Unloading material	.....	$54.00	65.15	63.70	139.81
Building forms	$407.70	136.80	295.20	217.80	665.91
Mixing and placing	$1,240.75	396.05	495.70	597.10	506.15
Back-filling & tearing down molds	$262.85	148.60	136.25	111.45	128.02
Not classified	$360.25	.....	.....	45.85	214.22
Total labor	$2,910.60	866.60	1,132.80	1,248.10	1,999.63
Average per yd.	$2.97	2.97	2.97	3.53	1.74
Material:					
Cement, sacks	3,749	1,179	1,611	1,512	5,168
Value	$1,986.95	532.05	853.85	801.35	2,248.08
Sand, cubic yards	468	134	188	158	576
Value	$140.40	53.60	75.20	63.20	172.80
Stone, cubic yards	936	260	375	333	280
Value	$567.80	156.00	187.50	166.50	168.00
Slag, cubic yards	.....	.....	.....	.....	945
Value	.....	.....	.....	.....	245.70
Lumber, value	$543.35	125.00	121.50	167.05	362.62
Miscellaneous	$30.00	15.00	77.15	.....	61.30
Total material	$3,268.50	866.65	1,253.05	1,275.25	3,258.50
Average per yd.	$3.30	2.96	3.09	3.60	2.63
Grand Total:					
Labor and material	$6,179.10	1,733.25	2,385.85	2,523.35	5,258.13
Average per yd.	$6.27	5.93	5.88	7.13	4.32

TABLE II. SHOWING COST OF CONCRETE WORK PROPER IN CERTAIN STRUCTURES.

	16 ft.culv. No. 25.5, Nashville Division.	12 ft.culv. No. 133.3, Chattan'ga Division.	12 ft.culv. Doe Creek, McMinnville Br.	10 ft. culv. No. 1.0, P. & M. Division.	12 ft.culv. No. 55.7, Nashv'le Division.
Labor Costs:					
Cubic yards	986	292	406	354	1,217
Unloading material, cost	.....	$54.00	65.15	63.70	139.81
Per yard	.....	.18	.16	.18	.11
Building forms, cost	$407.70	136.80	295.20	217.80	665.91
Per yard	.41	.47	.73	.61	.55
Mixing and placing, cost	$1,240.75	396.05	495.70	597.10	506.15
Per yard	$1.26	1.35	1.22	1.69	.42
Total:					
Labor	$1,648.45	586.85	856.05	878.60	1,311.87
Per yard	$1.67	2.00	2.11	2.48	1.08
Material Costs:					
Cement, value	$1,986.95	532.05	853.85	801.35	2.248.09
Per yard	$2.02	1.82	2.10	2.26	1.85
Sand, value	$140.40	53.60	75.20	63.20	172.80
Per yard	$0.14	.10	.19	.18	.14
Stone or slag, value,	$567.80	156.00	187.50	166.50	413.70
Per yard	$0.58	.53	.46	.47	.34
Lumber, value	$543.35	125.00	121.50	166.05	362.62
Per yard	$0.55	.43	.30	.47	.30
Total, material	$6,238.50	866.65	1,238.05	1,198.10	3,197.20
Per yard	$3.29	2.96	3.05	3.38	2.63
Grand total:					
Labor and material	$4,886.95	1,453.50	2,094.10	2,076.70	4,509.07
Average per yard	$4.96	4.97	5.16	5.86	3.71

dumping the concrete into its final position in the wall without rehandling. After reaching a point 2 feet above the spring line, one of the tracks was removed and the other shifted to a position directly above the center of the arch, so as to reduce the handling of concrete to a minimum. Three men were required to

The concrete consisted of a 1-3-6 mixture, slag and stone being used as the aggregate. It was intended to use slag exclusively, but delays in shipment of the same necessitated substituting stone for about one-third of the work.

All excavating for the foundation, unloading of the material, mixing and plac-

ing of the concrete was done by one of the regular concrete forces of the railway, composed of 4 white men and 13 negroes, the rate of pay being as follows:

1 foreman, white	$3.50
1 mason, white	3.50
1 carpenter, white	2.25
1 blacksmith, white	2.05
5 laborers, black, at $1.20	6.00
8 laborers, black, at $1.10	8.80
Total	$26.10

Usually this gang builds the forms as well as doing all other work; but owing to the size of the culvert and the haste to complete concreting before cold weather, the platforms were erected by a bridge crew of white men, whose pay ranged from $1.75 to $2.25 per day. This slightly increased the cost of building forms, but secured rapidity of construction of the culvert.

The concrete gang moved to the work on Sept. 12 last, excavated 853 cubic yards of earth, unloaded the material for and mixed and placed 1,217 cubic yards of concrete, removed the forms and bins, loaded all timber used in construction, etc., and moved away on Nov. 9. During this time they lost three days on account of rain and closed down one day for lack of material. The mixer was in operation 194 hours, and mixed 7,702 batches, or at the rate of 1 batch every 87 seconds during the entire time it was in operation. During the last 10 days it mixed a batch every 78 seconds while running. The best record made was 291 batches in five hours, being 1 batch every 63 seconds, or at the rate of 58 batches, equal to 9.2 cubic yards of concrete in place per hour. This is about equal to the capacity of the machine, one-half minute being required to mix the concrete, and at least that much time is consumed charging and discharging it. A No. 5 Chicago improved cube mixer, operated by a Bates & Edmunds Motor Co. gasoline engine, was used, and gave satisfaction; but a larger size would have been more economical, as all cement had to be measured, which required an additional man, the amount required for each batch being two-thirds of a sack. Another objectionable feature of the small machine was the size of the charging hopper, which caused a tendency to choke if the entire contents of a wheelbarrow was dumped into it at once. One man was required, therefore, to keep the hopper open, thus causing a delay in charging the mixer, which materially reduced the daily output of the same.

For the purpose of comparing the cost of this culvert with that of others built by the railway, I have taken from the tables accompanying the paper of Mr. H. M. Jones on "Concrete and Concrete Costs," submitted to the Engineering Association of the South in October, 1904, four examples of culverts approximating the conditions existing at Yellow Bank, and have compared with them the costs of this work. Table No. 1 gives the total cost of each of the structures, while in Table No. 2 is shown the cost of concrete work proper. An inspection of Table No. 1 shows that the labor cost at Yellow Bank is only 58 per cent. of the labor cost at Doe Creek culvert, McMinnville branch, the cheapest of the other culverts; while the material cost is nearly the same, the reduction being mainly the difference between the cost of slag used at Yellow Bank and of crushed stone used at the other place. The reduction in labor cost is due largely to the use of a mechanical mixer, although the large yardage and the economical methods employed in handling material were factors in bringing about this reduction.

MUNICIPAL AND TECHNICAL LITERATURE

New Publications.

Brayton Standards. A pocket companion for the uniform design of reinforced concrete. By Louis F. Brayton, Consulting Engineer. 110 pp., leather pocket book, $3. Louis F. Brayton, Minneapolis, Minn.

The rapid extension of the use of reinforced concrete and the much less rapid spread of knowledge of methods of designing structures in reinforced concrete have created a demand for such a book as Mr. Brayton presents. While it is true, as Mr. Brayton says in his preface, that "reinforced concrete has ceased to be an experiment in the hands of a specialist," it is only true in the sense that it is now possible to design structures which will undoubtedly be safe. The

most economical distribution and use of material has not yet been definitely determined to the satisfaction of all of the experts and must still be a subject of study and experiment. Each of the promoters of proprietary systems of reinforcement has his own method of designing and it has been common to require contractors for structures to supply their own plans for building. As competition increases the objections to this method increase in number. The cheapening of construction to meet prices of competitors may lead some below the line of safety. The expense of making as many plans for a building as there are systems offered must be met by some one. The architect or engineer who does not make himself able to compute, or at least check the computations for designs puts himself at the mercy of the contractors offering them. The selection of a single kind of proprietary reinforcing system lays the designer open to the charge of undue influence. The lack of convenient methods of determining sections and proportions has led the busy engineer or architect to shift the responsibility, so far as he has been able, to an expert in a single system or to open competition of the contractors.

Mr. Brayton's book is the first which gives forms, tables and instructions for the general design of reinforced concrete structures. His designs use no patented materials or systems, but are capable of modification to use them in case the successful contractor wishes to use them, and gives a uniform standard of design which all must attain, thus putting all bidders on a practical equality.

The author claims that the Brayton standards are conservative and as accurate as is consistent with this class of work. This is practically admitting the assertion made above, that the advancement in the design of reinforced concrete has not yet yet reached the stage of highest economy.

The book opens with a dedication of Mr. Brayton's patents to the public. It includes short statements of the principles and theory of design, location of steel, distribution of load in a rectangular panel and slab reinforcement. Some of the theories advanced are not accepted by all engineers, but they seem to err, if at all, on the side of safety.

Then follow figures showing various methods of slab reinforcement and methods of determining bending moment; tables of bending moments in slabs of spans from 5 to 24 feet, with various total loads from 75 to 1,000 pounds per square foot. The span of slab on page 25 is said to be in inches, apparently an error, as all the other spans are given in feet. A table gives dimensions, weights and maximum stresses and moments of resistance of slabs of various thicknesses from 2 1-2 inches to 18 inches. Moments of resistance of slabs one foot wide, and of various diameters and spacing of reinforcing rods are tabulated for slabs from 2 1-2 to 12 inches thick. Another table gives the thickness of slab necessary to carry a given load per square foot on a given span. Properties of wire and round rods are given in a series of tables.

Beam reinforcement is then taken up and standard methods are shown in illustrations. The following tables give bending moments in simple beams of various spans and loadings, and moments or resistance of beams of the designs shown for the various types, diameters and tensile strengths of reinforcing rods, height of beam, etc. Shear loops are computed in another table.

Columns of square cross section 10 to 24 inches square, and 12 to 22 feet high, can be designed from the next series of tables, which give full data regarding dimensions of reinforcement, weight and safe loads. Column binders are computed in a supplementary table.

Footings, stairs, methods of constructing forms, dimensions of form lumber, proportions of materials in concrete of gravel and stone of various sizes, and standard forms of rods for beams, columns and a typical frame occupy the last sixteen pages of the book.

The architect reports the book well nigh indispensable, and it is certainly a commendable effort to meet a large and legitimate demand.

The Business of Contracting. By Ernest McCullough, Consulting Civil Engineer, Chicago, Ill. 45 pp., paper. 50 cents. Technical Book Agency, Chicago, Ill.

Mr. McCullough has collected in this booklet some articles written for *The Contractor*, and he gives out of his experience and observation some valuable hints as to the personnel, organization and operation of a contracting business.

The subject of the first chapter is the staff and it outlines its organization and gives suggestions as to the qualifications and probable duties of the manager and the superintendent. The foreman is given a chapter by himself. One of the chapters on bidding is devoted mainly to the difficulties which a contractor may meet if he fails to take sufficient account of some small but important clause or paragraph in the specifications; another gives many practical hints on details of information liable to be overlooked in making a bid.

The chapter on working methods dis-

cusses "cost plus a fixed sum" and the arrangement of the office and yard on a sewer contract. The force in the office and the methods of keeping records and making reports, are given a chapter. Another treats of such details as house drain soliciting and records, blanks for reports of foremen, etc., handling of workmen, daily records of work done, value of telephone, team work, machinery problems, etc., and a short summary of ideas necessary to success in the contracting business.

The author has an interesting style of imparting information and his booklet is well worth a place in the library of young engineers and contractors, even if that library is only of pocket or trunk size.

City Roads and Pavements Suited to Cities of Moderate Size. Third edition, revised. By William Pierson Judson, M. Am. Soc. C. E. 197 pp., cloth. $2 net. Engineering News Publishing Co., New York.

That this book meets a demand satisfactorily is shown by the call for three editions in four years. This new edition is mainly the same as the second, some additions having been made in both text and foot notes to give recent changes in paving methods. These add to the reasons for the favorable opinion of this book already expressed in this magazine.

The municipal official who wishes to acquaint himself with the best methods of street paving can do so most readily by reading this book, which is written in interesting style and not too much technical detail.

The Cement-Worker's Hand-Book, covering more than fifty most important subjects on cement and its uses in construction. Compiled to meet the requirements of the common workman. By W. H. Baker. 86 pp., cloth. 50 cents. Myers Printing Co., Akron, O.

The title to this book gives its scope and field. The titles of the various parts are Cement, Mortars, Concretes, Cast Masonry, Practical Notes on Cement Work. For what should be classed as common work it meets a demand, but the best class of work requires much more careful workmanship and more knowledge of mixtures and methods of placing than this book describes. The development of the use of concrete of the kinds described in this book has been very rapid and they have been used in many permanent structures, the appearance of which is anything but satisfactory, although the conditions of stability and permanence are fully met. There are now some indications that the demand for the future will be for handsome work as well as for durable work. With the warning that this book covers the latter class, but not the former, it is placed before our readers for their consideration.

Ordinary Foundations; including the coffer-dam process for piers, with numerous practical examples from actual work. By Charles Evan Fowler, C. E. Second edition, revised and enlarged. 340 pp., cloth. $3.50. John Wiley & Sons, New York City.

This is an amplification of Mr. Fowler's former book on the coffer-dam process for piers. It includes from the former book chapters on historical development, construction and practice in crib coffer-dams, and cribs and canvas, pile driving and sheet-piles. metal construction with several pages of additional matter on sheet piling, pumping and dredging, the foundation, location and design of piers, with new chapters on cylinders and caissons, additional chapters on the foundation and location and design of piers, and new material regarding cement and concrete and timber piers and timber preservation.

Appendices give specifications for Ohio river movable dams, Topeka bridge foundations, Katte's masonry specifications, and specifications for a steel coffer-dam from the former book, with new specifications for cement from the American Society for Testing Materials and for metal sheet-piling.

A very favorable opinion was expressed by MUNICIPAL ENGINEERING regarding the earlier book and the additions to it in this volume are of the same high character. The main interest is still in the coffer-dam process, but cylinders and caissons are clearly, though briefly, described and timber piers are treated at some length. The additions to chapters bring in some new material and some descriptions of earlier difficult foundations.

This is a standard work upon its subject worthy a prominent place in the engineer's library.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. An encyclopedia of mechanical movements and mechanical appliances, including many novelties of construction used in the practical operation of the arts, manufactures and in engineering. For engineers, draughtsmen, inventors, patent attorneys and all others interested in mechanical operations. Including an explanatory chapter on the leading conceptions of perpetual motion during the past three centuries. By Gardner D. Hiscox, M. E. 400 pp. 976 illustrations. Cloth, $3. The Norman W. Henley Publishing Co., 132 Nassau street, New York City.

The title page, quoted above, gives a fair description of the contents of this book, which is hardly deserving, however, of the title encyclopedia, although it contains brief descriptions of 970 mechanical appliances, each illustrated with a drawing. They are arranged in sections, the lever, transmission of power, measurement of power, generation of power, steam power, explosive motor power, hy-

draulic power, air power motors, gas and air-gas devices, electric power, navigation, and vehicles, railways, gearing, motion control, clocks, mining, mill and factory tools, textile manufacturing, engineering construction, draughting and miscellaneous, and the section on perpetual motion.

ORGANIZATIONS AND INDIVIDUALS

Technical Meetings—N. E. Water Works Association—League of American Municipalities—Personal Notes.

League of American Municipalities.

As this number of MUNICIPAL ENGINEERING goes to press the Chicago convention of the League of American Municipalities is in session. The indications of the first day were for a large attendance and the local committee, of which

JOHN McVICAR, DES MOINES, IOWA,
Secy L. A. M.

Mr. Hugo S. Grosser, city statistician, is a prominent member, has prepared an excellent program of entertainment and a souvenir program of elaborate form and large extent. The program of papers, which has already been printed in this magazine, promises instruction and discussion of interest and value equal to the other attractions of the meeting. John MacVicar, the secretary, has done good service in its preparation.

Technical Meetings.

The annual convention of the American Street and Interurban Railway Association will be held at Columbus, Ohio, October 15 to 19. Bernard V. Swenson, secretary, 60 Wall st., New York city.

The fourteenth annual convention of the National Irrigation Congress was held at Boise, Idaho, September 3 to 7. Officers elected for the ensuing year were as follows: President, James Stephenson, Jr., of Idaho; secretary, Clarence T. Johnson, of Wyoming. The next meeting will be held at Reno, Nev., April 8, 1907. The next annual meeting will be held at Sacramento, Cal., at a time to be determined later by the executive committee.

The thirty-second annual convention of the International Association of Fire Engineers will be held at Dallas, Tex., October 9, 10, 11 and 12.

The annual convention of the American Civic Association will be held at Milwaukee, Wis., October 24, 25 and 26.

New England Water Works Association.

The twenty-fifth annual convention of the New England Waterworks Association was held at the Fabyan House, in the heart of the White Mountains, September 12, 13 and 14. A number of practical experience papers were considered by the association. Charles W. Sherman reported that considerable interest had been aroused among engineers by the

standard specifications adopted by the association. He said that in the two years since their adoption about 3,500 copies have been sold, besides two orders of 1,000 each. The New American Pipe Co., of Birmingham, Ala., and the works at Lynchburg have adopted the specifications as their standard, but the United States Cast Iron Pipe and Foundry Co. has refused, so far, to book orders under them. Frank L. Fuller submitted a report for the committee on uniformity in the direction of opening hydrants and valves and of the size and shape of hydrant and valve nuts, disclosing the fact that there is no standard size or shape for hydrant nuts. Also, that wrenches that fit hydrants in some towns open to the right, and others to the left. In

HUGO S. GROSSER, CITY STATISTICIAN, CHICAGO, ILL.

some towns the hydrants open one way and the gates the opposite way, and there are even waterworks where some gates open one way and some another. The committee submitted recommendations, as follows:

After careful consideration of present conditions and an earnest effort to judge wisely as to the future, your committee suggests for the consideration of the association the following recommendations:

1. In new systems all hydrants and valves shall turn to the left to open.

2. All additions and repairs to existing systems of hydrants and valves shall be such that there shall be continued uniformity in the direction of opening, whether it be to the left or to the right. If no uniformity already exists, all new apparatus shall turn to the left to open.

(a) A city or town having an established system of waterworks should continue to instal hydrants and valves having the same operating nuts and openings in the same direction as those already in use, unless it has been decided to at once change all old hydrants and valves to the new standard. This principle is imperative and no departure should be made from it. It is unfortunate that entire uniformity was not earlier advocated and adopted. The very rapid increase in waterworks appurtenances, great numbers being turned out daily, increases the importance of uniformity.

3. All fire hydrants shall have a pentagonal (five sided) operating nut finished without taper to 1 1-2 inches from "point to flat." The nut socket in the wrench shall be made without taper so as to be reversible.

(a) The size and shape of nut is in quite general use and has been recommended by the National Fire Protective Association.

4. An arrow at least 6 inches long, showing the direction of opening and the words "to open" in distinct letters at least 3-4 inch high, shall be cast with 1-8 inch relief, upon the top of all fire hydrants.

5. All valves connected with street mains shall have an operating nut 1 15-16 inches square at the top, 2 inches square at the base, and 1 3-4 inches high.

6. The operating nut on all valves shall be made with a flanged base upon which shall be cast an arrow, at least 2 inches long, showing the direction of opening and the word "open" in distinct letters at least 1-2 inch high.

The standard direction for opening hydrants and street valves is a perplexing question and there are sure to be differences of opinion. The standards recommended are for new systems and for such others as choose to change. It will be many years before entire uniformity can be secured and then only by the earnest co-operation of those who believe uniformity to be worth striving for.

A discussion of the report brought out the fact that no standard had been recommended by the committee for the auxiliary or independent valves of fire hydrants, and the report was referred back to the committee for further investigation.

Personal Notes.

Charles F. Sturtevant has been appointed city engineer at Perry, Iowa.

John W. Hill has resigned as chief engineer of waterworks, at Cincinnati, O.

W. B. Pason has been appointed assistant city engineer at Wilkes-Barre, Pa.

Harvey L. Shaner has been appointed assistant city engineer at Lynchburg, Va.

William S. Bacot has resigned as engineer of the Consolidated Water Co., at Utica, N. Y.

George Turner, city engineer of Bay City, Mich., for twenty years, died August 30, aged 71 years.

P. B. Leivy has been appointed city engineer at East St. Louis, Ill., to succeed George H. Meck, resigned.

A. J. Grant has been appointed assistant engineer of the city of Rochester, N. Y., succeeding Willard D. Lockwood, resigned.

J. C. Herring, city engineer at Jefferson City, Mo., has removed to Kansas City, Mo., where he has established an

office and will practice as civil and consulting engineer.

M. J. Herman has been appointed street commissioner and John M. Olds city clerk by Mayor Harley A. Logan, at Plymouth, Ind.

Henry Clay Slaney, chief engineer of the Williamsburg Gas Light Co., died at his home in Brooklyn, N. Y., recently, aged 55 years.

James F. Parr, asst. city engineer for five years under a former administration at East St. Louis, Ill., has been appointed to that position again.

Benjamin F. Hetherington, president of the Hetherington & Berner Iron Works Co., died at his home in Indianapolis, Ind., September 15, aged 77 years.

Messrs. Fred W. Green, Thos. O'Brien, and Ward L. Roach have been appointed members of the board of health by Hon. John W. Call, mayor of Elwood, Ind.

J. N. Kennedy, superintendent of the Alma Cement Co., Wellston, O., has resigned and is now associated with B. B. Lathbury, consulting engineer, Philadelphia, Pa.

George W. Craig has resigned as assistant city engineer of Omaha, Neb., for the purpose of engaging in engineering and contracting, with offices at 422 Bee building, Omaha.

A. L. Stewart has been appointed city engineer, Ray Lakin street commissioner, and Oliver Ong superintendent of city water and light plant, by Hon. Harvey M. Cowing, mayor of Rushville, Ind.

C. W. Swearingen has been appointed city engineer at Great Falls, Mont., to succeed George W. Bird, resigned. Mr. Swearingen resigned this position May 12, 1903, after eleven years' service, to accept the position of engineer for a sewerage system, waterworks, parks and general municipal improvements to be installed at Havre, Mont.

MACHINERY AND TRADE

The Modern Methods of Testing Road Materials.

In years gone by, and in some out of the way places now, road building was and is, a matter of guess, perhaps at times a shrewd guess. Sod could be dumped into the middle of the road, two or three inches of gravel from a nearby pit could be spread and the road would be finished. Passing carriages and carts did the rolling. The problem before the modern road builder or engineer is to procure a road surface, as free from wash as possible, of hard material. This material has to withstand grinding, and some rock is sooner reduced to powder than another. The powder may have a certain cementing value, depending again upon the rock quality. The modern builder, therefore, has need of some method of testing and of certain apparatus to obtain knowledge of the wear of the rock and of the cementation of the powder. The test for the wear of the rock or the abrasion test, in one form, was started in France, and the first machine designed especially for testing road materials was exhibited at the Paris Exposition of 1878. This machine was the forerunner of the present Deval Abrasion Machine.

The modern form of the Deval machine consists of four or eight iron cylinders mounted on a shaft, so that the axis of each cylinder is at an agle of 30 degrees with the axis of rotation. The dimensions of the cylinder are 20 cm. in diameter, 34 cm. in depth. The cylinders are closed at one end, with a tightly fitting iron cover at the other. The shaft and cylinders are rotated by means of a pulley and belt. By having so many cylinders it is possible to make four or eight tests simultaneously.

For the test, the rock sample is broken up into pieces, as nearly uniform as possible, such that they will pass in all positions through a 6 cm. ring. After the broken pieces have been cleaned by washing and drying, five kilograms of the rock are placed in one of the cylinders. The cover is then securely fastened on and the cylinders turned at a rate of 2,000 revolutions per hour. The fragments of stone are thrown from one of the cylinders to the other twice each revolution, thus causing the pieces to grind and pound one another as well as the cylinder ends. The machine is stopped at the end of five hours or 10,000 revolutions, the cylinders are opened, and the contents emptied into a pan. The cylinder and cover are then carefully washed, and the washings are poured into the pan. All dust adhering to the stone is removed by brushing and washing each piece under the water. After drying, the detritus is separated into the following three sizes: above 1 cm., between 1 cm. and 0.16 cm., and below 0.16 cm. Only

the material below 0.16 cm. is used for the purpose of the test, the weight of which is recorded.

When these tests were first made, a standard rock of superior wearing quality was always placed in one of the cylinders as a standard of comparison. The proportion of the weights of the dust under 0.16 cm. from the standard rock and from the tested rock was assumed to give their relative resistance to abrasion. Only the best varieties of rock gave less than 100 grams of powder under 0.16 cm., which would be 20 grams of powder per kilogram of rock, or 2 per cent. of their weight.

The "coefficient of wear" for any rock tested may be obtained from this formula:

$$\text{Coefficient of wear} = 20 \times \frac{20}{W} = \frac{400}{W}$$

in which "W" is the weight of the detritus, in grams, under 0.16 cm. in size obtained per kilogram of rock used. The value 20 is the adopted value for a standard of excellence, obtained from the use of a standard rock in one of the cylinders.

The cementation test is next of importance. The binding or cementing power of rock dust is such an important element in road building that much time has been spent in devising a suitable method for determining the degree to which the different rocks and gravels possess this property. Many tests have been tried, but as yet the impact test, followed out in a uniform manner, as described below, has given satisfactory results.

One kilogram of the rock to be tested is broken sufficiently small to pass a 6 mm. but not a 1 mm. mesh screen. It is then placed in a ball mill and is ground for two and a half hours. This ball mill contains two chilled iron balls which weigh 25 pounds each, and is rotated at a rate of 2,000 revolutions per hour. The above rate was found experimentally to be sufficient to reduce the rock to a powder that would pass through a 0.25 mm. mesh. The dust from the ball mill is mixed with just water enough to form a stiff dough, and is kept in a closed jar twenty-four hours. About 25 grams of this dough is placed in a cylindrical metal die, 25 mm. in diameter. A closely fitting plug is then inserted, which is then subjected to a pressure of 100 kilograms per square centimeter.

It is most important that these briquettes should be compressed in a uniform manner, hence a hydraulic press is used, so arranged that the pressure is automatically controlled. The dimensions must also be uniform, hence enough material is added or subtracted to give a height of exactly 25 mm. after the pressure has been removed. Five briquettes are made from each sample test, and allowed to dry twelve hours in air and twelve hours in a steam bath. After cooling in a desiccator, they are tested by impact in a machine especially designed for the purpose. It consists of a 1 kilogram hammer, which is guided by two vertical rods. The hammer, which ends in a small cone at the tip, is caught on the lower side of the cone by two spring bolts and is lifted by a cross-head which is joined to a crank shaft above. A vertical rod, which is directly over the hammer cone, can be adjusted by thumbscrews to give a drop to the hammer varying from a fraction of a mm. to 10 cm. This rod has a hollow cone at its lower end, into which the cone of the hammer head is thrust when the hammer is lifted by the cross-head. When the cone of the hammer head is brought into the cone of the adjusting rod the hammer is exactly centered and brought free of the guide. As the cross-head continues to rise, the bolts supporting the hammer, which are tapered at an angle of about 45 degrees, are thrust open by the sloping head of the adjusting cone rod releasing the hammer, which falls on a flat end plunger of 1 kg. weight, which is pressed upon the briquette by two light spiral springs surrounding the guide rods. This plunger is bolted to a cross-head. A small lever holding a brass pencil at its free end is connected with the side of the cross-head by a link motion arranged so that it gives a vertical movement to the pencil five times as great as the movement of the cross-head. The pencil is pressed against a drum, and its movement is recorded on a slip of silicated paper fastened thereon. The drum is moved automatically through a small angle at each stroke of the hammer. In this way a record is obtained of the movement of the cross-head during and after each blow of the hammer. To the cross-head is fastened a steel rod which passes up through the cross-head and through a piece of metal securely attached to the cone rod. At this junction a vernier scale is graduated, by means of which the height of the blow of the hamhammer can be accurately set to 0.1 mm., and by lowering the cone rod until it rests on the hammer zone the height of the briquette can also be measured to 0.1 mm.

The standard fall of the hammer for a test is 1 cm., and this blow is repeated

until the bond of cementation of the material is destroyed. The blow producing failure is easily ascertained, for when the hammer falls on the plunger, if the material beneath it can withstand the blow, it recovers; if not, the plunger stays at the point to which it is driven, and in either case the behavior of the test piece is recorded on the drum. The automatic record thus obtained from each briquette can be saved for future reference. These records are similar in appearance to the record obtained in Keep's test on cast iron; that is, a series of steps, each step showing the blow struck and the yielding of the test piece.

For further details concerning these tests the reader is referred to Bulletin No. 79 of the Bureau of Chemistry, wherein will be an article by L. W. Page, Chief of the Road Material Laboratory, one who has done much toward improving the tests and the machines.

Both of the pieces of apparatus, as well as the briquette molding machine, are now constructed by the International Instrument Company, of Cambridge, Mass. The machines as constructed by this company and designed by Mr. Page are now much improved, especially the impact apparatus, which has been made more compact.

Information concerning these machines will be gladly furnished by the company.

The Kansas City Portland Cement Company.

The Kansas City Portland Cement Co.'s office is located in Kansas City, Mo., Room 708, Heist Bldg., and the plant is now in course of construction on the Missouri river, three miles north of Independence, Mo. The capital stock of the company consists of $750,000 preferred stock and $750,000 common stock, full paid and non-assessable. The officers of the company are: F. E. Wear, president; W. H. Caffery, vice-president and general manager; W. H. Rule, treasurer, and A. L. Murphy, secretary. All men of unquestionable business ability and well known in both Kansas and Missouri. Much of the above stock has been subscribed for by the business men in and around Kansas City on account of the confidence they have in the above officials. The property of the company extends for a distance of one and a quarter miles along the Missouri river. The bluffs of solid cement—rock and shale, ranging from 250 to over 300 feet in height, have been examined and analyzed by fifteen of the best chemists of the country, who pronounce it to be of an excellent quality of material for the manufacture of Portland cement. The plant, which is being constructed by the Freeborn Eng. Co., is located at the base of the bluffs and all of the material will be handled by gravity, which will greatly reduce the cost of manufacturing. The location is pronounced by experts to be an ideal one. The shipping facilities of the company are certainly all that could be asked for, as both the Missouri Pacific and Santa Fe main lines pass within a distance of forty feet of the plant. The company also has arrangements made with the Santa Fe railroad to handle its cars at practically switching charges and puts it in touch with twenty-three trunk lines running out of Kansas City in all directions. Besides this, boats can be loaded from the store house and cement can be landed in Kansas City for less than 2 cents per barrel on the company's own barges. The buildings will be of reinforced concrete. The main building will be 560 feet long. The latest improved machinery of every pattern will be installed in this plant. The rotary kilns are 120 feet in length, with a daily capacity of 500 barrels per rotary. The Freeborn Engineering Company expect to have the plant completed about January, 1907.

A Refractory Concrete.

A new refractory concrete which, it is claimed, will answer every purpose for which fire-brick are used, is put on the market by E. R. Stowell, of New Corydon, Ind. He sends the following copy of a letter from Robert W. Hunt & Co., Testing Engineers, Chicago, Ill., regarding tests of the brick, addressed to D. S. Roberts:

Below we submit result of tests made on Refractory Concrete Fire Brick, samples received from you.

Several specimens were placed in a Muffle Furnace, heat was applied and the temperature gradually raised to 2,800 F. This temperature was maintained for fifteen minutes. One of the specimens was immediately thrown into cold water and permitted to remain until practically cooled. None of the specimens tested showed any signs of disintegration; in fact, they all appeared somewhat harder than the original brick; also, none of the specimens show any indications of fusion.

Trade Publications.

The Downard-Lester Rock Asphalt Co., Ardmore, Ind. Ter., distributes a leaflet giving an exposition of the properties, uses and merits and an explanation of the rock asphalt of Indian Territory.

The Sandusky Portland Cement Co. is able to issue new circulars frequently containing additional testimonials and evidence of the value of Medusa waterproof compound. The latest circular makes a special point of the possibility of omitting furring and lathing in houses built of hollow blocks, in which the waterproofing compound has been rightly used.

The Studebaker Bros. Mfg. Co., South Bend, Ind., have an occasional publication called "The Studebaker," intended principally for agents and dealers in their products.

The Perfection Block Machine Co., Kasota Bldg., Minneapolis, Minn., has a new catalogue showing the merits of the Perfection power block machine, the various forms of blocks made on it and the machinery it is desirable to have in a well-appointed plant. M. K. Sawyer, Hotel Cadillac, New York City, is the eastern representative of the company.

The Chicago Pneumatic Tool Company announce that they will receive from the printers Sept. 15, their new Compressor catalogue, consisting of 118 printed pages, printed in two colors, in which several new types and sizes of compressors are shown, including their new Hamilton Corliss Machines. Those interested will receive copy upon request.

The Clinton block's merits and the location of the cities for which they have supplied blocks each year since 1894 are set forth in a leaflet which can be obtained, with other information, from the Clinton Paving Brick Co., Clinton, Ind. The number of duplications of orders, extending over periods of years, is a notable feature of the list.

The Vulcanite Portland Cement Co., Land Title Bldg., Philadelphia, Pa., has issued a new booklet in its series of papers on subjects of interest to cement users. It is entitled "Economical Selection and Proportion of Aggregates for Concrete," and it is by Albert Moyer, who is in charge of the company's sales department in the Flat Iron Bldg., New York City.

The Portland vitrified conduit system of insulating underground steam and hot water pipes is described in a booklet issued by the H. W. Johns-Manville Co., Milwaukee, Wis.

Many designs of sheet steel ceilings are shown in a handsomely illustrated catalogue sent by the Berger Mfg. Co., Canton, O.

The Standard Waterproofing Co., Indianapolis, Ind., issues a booklet giving "A Way to Prevent Damp Walls." Pictures show clearly the difference between sections of the same wall waterproofed and not treated, and letters show the satisfaction of those who have used the substance, which is applied like paint, does not discolor and is permanent.

The American Hydraulic Stone Company, Denver, Colo., have issued a new illustrated catalogue, showing their system of artificial stone making and building therewith in great detail. It contains also a full list of the patent claims held by the company and the drawings accompanying the patents.

Trade Notes.

ASPHALT.

Bluffton, Ind.—This city has purchased an asphalt plant of Hetherington & Berner, of Indianapolis, and will pave and repair its own streets.

Memphis, Tenn.—The Memphis Asphalt Co. has purchased a tract of land and will erect an asphalt plant.

Spokane, Wash.—The Independent Asphalt Paving Co. has purchased land and will erect an asphalt paving plant. The building will be two stories high, 40x175 feet, and of steel and cement. Cost, $12,000. A. F. Gill, mgr.

Indianapolis, Ind.—P. C Reilly, of the Republic Chemical & Creosoting Co., has been granted a patent for the manufacture of a new bituminous macadam pavement, to be called bitu-mineral.

BRICK.

Devil's Lake, N. D.—A sand-lime brick plant is contemplated here.

Bay City, Mich.—The Michigan Vitrified Brick Co. has been awarded the contract for supplying the brick for the new mechanical engineering building at the Michigan Agricultural college.

Topeka, Kas.—The Kaw Valley Brick & Tile Mfg. Co. has bought the Willard brick plant, formerly under the control of the Topeka Tile & Brick Co. The plant is located at Willard, Kas., a small town near here. Additional machinery will probably be installed for manufacturing vitrified paving brick. The officers of the company are: President, T. E. Armstrong; vice-president, W. R. Blackburn, of Willard; treasurer, C. M. Hossack, Willard; secretary and general manager, E. E. Fourt.

CEMENT.

Alpena, Mich.—J. W. Paxton, of Detroit, is negotiating with this city for the location of a Portland cement plant here. Associated with Mr. Paxton are J. B. and E. L. Ford, of Toledo; B. F. Barrie, S. T. Crape, H. Paxton, of Detroit; Geo. B. Morley, of Saginaw, Mich.; Geo. R. Ford, of Toledo.

Wyandotte, Mich.—The Michigan Alkali Co. has purchased 50 acres of land here on the Detroit river, and will erect a 15,000-barrel cement plant.

Winnipeg, Man.—The Portland Cement Co., Ltd., has been organized to erect a plant at Gonor, 14 miles northeast of here.

Hays City, Kas.—I. M. Yost is promoting a cement plant, to be erected 6 miles west of here, where chalk deposits have been located. A town, to be known as Yocemento, will be built at the site.

Oakland, Cal.—The Southern California Cement Co. has been incorporated by

Geo. W. Reed, Percy C. Black, Clarence M. Reed, B. H. Griffins, Rod W. Church, Cecil T. Walker and J. L. Rose.

New York City—The American Gypsum Co. has been incorporated to quarry for gypsum rock, manufacture plaster, etc., by Charles L. Hunt, Harry C. Nobles and Carroll E. Bowen, of Rochester, and others.

San Francisco, Cal.—The Santa Cruz Portland Cement Co. will erect a large cement manufacturing plant at Bellingham Bay, on Puget Sound, soon. Wm. J. Dingee and Dr. I. A. Bachman are the principal stockholders.

Bozeman, Mont.—Ed C. Davis and Fred T. Osburn, of this city, contemplate establishing a cement mill near Sappington, on the N. P. railroad.

Bridgeport, Ala.—The big cement plant to be located here, at a cost of $1,000,000, will be started October 1, and will have a capacity of 1,000 barrels daily. G. W. Nicholson, of Iola, Kas., will have charge of the plant.

The Northwestern States Portland Cement Co. expects to work night and day upon its new plant at Mason City, Ia., to complete it in time to put it in operation in the spring of 1907.

The Medusa Waterproof Compound of the Sandusky Portland Cement Co. is being used by the Curtin-Ruggles Co. of New York City in 200,000 square feet of cement roofing for the Orford Copper Co., at Bayonne, N. J.

CONCRETE.

Chicago, Ill.—The Weber Concrete Chimney Co., of this city, is erecting a reinforced concrete chimney for the pumping plant at Eldora, Ia. The chimney will be 75 feet high and will cost $1,125.

Chicago Heights, Ill.—The Chicago Heights Artificial Stone Co. has been incorporated by Charles F. Norton, Lena Norton and Arthur Larider.

Jersey City, N. J.—The Construction Utilities Cement Co. has been incorporated by Fred A. Chamberlain, Patrick Egan and Paul R. Jones.

Pittsburg, Pa.—The Reinforced Concrete Construction Co. has been incorporated by Geo. L. Brown, of Ben Avon; Jas. McCahon, of Oakmont; G. C. Langenheim, Allegheny; John R. Brown, Pittsburg; Thos. J. Brown, Edgewood.

Hackensack, N. J.—The Van Buskirk Building & Cement Block Co., 342 Main st., has been incorporated to manufacture cement blocks and other building materials and conduct a contracting business. Elmer Van Buskirk, Herman Abensath, Chas. Fleishman and Frederick Fleishman are directors.

Indianapolis, Ind.—Daniel B. Luten has been granted a patent on a system of reinforcement for concrete and similar structures.

New concrete block companies:

Tekamah, Neb.—Tekamah Cement Products Co.—J. S. Crue.

Onalaska, Wis.—J. H. Bucklen and Fred Holthouse, cement blocks and moldings.

Highland, Wis.—The Highland Hollow Concrete Wall Co.—T. F. Kennedy, Walter B. Potter, Clavert Spensley.

Lanesboro, Ia.—M. A. Billings.

Grand Meadow, Minn.—Tony Bipple.

Eau Claire, Wis.—Wm. Palmer.

Araphoe, Neb.—Richard Bros.

Clarkston, Wash.—Potter & Wickershow.

Spokane, Wash.—The San Poil Cement Plaster Co.

Glencoe, Minn.—George McAllister, of New Auburn.

West Concord, Minn.—Goodwin Bros.

New Orleans, La.—A concrete coffin factory will be erected here by H. W. and S. H. Richards, of Louisville, Ky.

Anoka, Minn.—E. A. Hibbard has devised a block machine for making cement blocks for curbing circular wells.

Fergus Falls, Minn.—A party of capitalists from the southern part of the state have been conferring with the officers of the Commercial Club relative to the establishment of a cement brick plant in this city.

PURCHASE OF MACHINERY.

Cresco, Ia.—Special.—A. H. Brown advises us that he is in the market for all kinds of cement tools.

Oconomowoc, Wis.—Special.—Walter H. Nelson, P. O. Box 425, is in the market for machinery and tools for cement walks, concrete walls and anything generally that cement can make.

Wichita, Kas.—Special.—Geo. H. Beasford, of the Wichita Construction Co., desires to purchase machinery and tools for concrete bridge construction.

Kenton, O.—Special.—The Cement Block & Roofing Co. is in the market for machinery and tools for cement blocks and roofing, and all kinds of cement work.

Horse Cave, Ky.—Special.—Clarence Owens is in the market for wood working machinery and a 12 to 15-ton h. p. gasoline engine.

Lafayette, Ind.—Special.—George P. Herzog is in the market for machinery and tools for concrete work.

Indianapolis, Ind.—Sealed bids are asked until October 6 for furnishing one automobile for the use of the county. Thos. E. Spafford, chmn. co. comrs.

Brookville, O.—Special.—H. H. Riley is in the market for cement block machinery.

Oil City, Pa.—Special.—H. F. Wm. Schubert, 17 Grove ave., is in the market for hand-power hoisting crabs and derricks.

Hoopeston, Ill.—Special.—Geo. Taylor Nicoson is in the market for block machines, mixers and cap and sill molds.

Olean, N. Y.—Special.—Jas. Weatherell, 134 S. Berry st., is in the market for a derrick and appliances, and cement and concrete mixers.

Hickory, N. C.—Special.—Abee & Edwards, general contractors, advise us that they are interested in work for which machinery and tools may be used in concrete work of all kinds.

Mound City, Ill.—Special.—C. J. Murphy, general manager Mound City Crystal Ice Mfg. & Coal Co., is in the market for machinery and tools for paving.

East Brady, Pa.—Special.—Peter Myers advises us that he is in the market for cement sewer pipe molds and cement block machines.

San Antonio, Tex.—Special.—P. T. Shields, 1712 N. Olive st., is in the market for a crusher for stone and cement blocks, a mixer and conveyors. He has ordered a Perfection block machine.

Bradford, Pa.—Special.—S. D. Winter, 19 Pike st., is in the market for cement machinery.

Deadwood, S. D.—Special.—James Hartgering advises us that he is in the market for mining machinery.

Florence, S. C.—Special.—The Florence Imp. & Mfg. Co. advises us that machinery and tools may be purchased for the Florence Iron Works and foundry.

Salem, Mass.—Special.—John J. Flynn & Son are in the market for machinery and tools for concrete construction.

Sioux City, Ia.—Special.—F. J. Sulzbach, 611 Main st., is in the market for machinery and tools for concrete and cement walks of all kinds.

Mauch Chunk, Pa.—Special.—John B. Duffy is in the market for machinery and tools for cementing, brick, walks, and plastering.

Toronto, Ont.—Special.—Sexton & Co., 17 Richmond st., E., is in the market for machinery and tools for building construction in brick, stone and cement.

St. Mary's, Pa.—Special.—M. C. Butsch is in the market for machinery and tools for concrete foundations.

Petersburg, Va.—Special.—Lewis O. Benson, 138 Harrison st., advises us that he desires to purchase lathes, planers and saws.

Franklin, Pa.—Special.—Samuel Burgard, 225 Pacific st., advises us that he is in the market for cement block and brick machines.

Wyoming, Pa.—Special.—Robert L. Safford is in the market for stone crushers, concrete mixers and block machines.

Philadelphia, Pa.—Special.—Edward A. Steele, 1600 Arch st., is in the market for machinery and tools for reinforced concrete.

Mineral Wells, Tex.—Special.—The South Mineral Wells Concrete Co., Box 182, is in the market for cement block machinery.

Baker City, Ore.—Special.—J. C. White, contractor, is in the market for engines, boilers, pumps and concrete mixers.

Youngstown, O.—Special.—William E. Sprague, 903 High st., advises us that he is in the market for machinery and tools for general contracting.

Ripon, Wis.—Special.—Wm. Kohl, 210 W. Fond du Lac st., is in the market for cement sidewalk tools.

Macon, Ga.—Special.—Jones Bros. are in the market for a continuous power concrete mixer.

Staples, Minn.—Special.—The Staples Lumber Co. advises us that it is possible they may purchase cement block machinery next season.

Salt Lake City, Utah—Special.—Frank Doran, 1512 S. 6th st., is in the market for concrete mixers and cement tools.

Stockton, Ill.—Special.—Schroeder Bros. advise us that they are in the market for concrete machinery.

Columbus, Ind.—Special.—Z. T. Sweeney advises us that he is in the market for a concrete mixer.

Galesburg, Ill.—Special.—Charles Miller, 1007 N. Cedar st., is in the market for machinery and tools for general contracting.

Butler, Ind.—Special.—John A. Fridenberger advises us that he is in the market for a block machine, a brick machine and a mixer.

Durham, N. C.—Special.—Herbert L. Smith, contr. and bldr., is in the market for builders' and contractors' tools.

PURCHASE OF MATERIALS.

Kenton, O.—Special.—The Cement Block & Roofing Co. is in the market for cement, sand, etc.

Horse Cave, Ky.—Special.—Clarence Owens desires to purchase several carloads of Portland cement at once.

Coshocton, O.—Special.—T. H. Burrell advises us that he is in the market for cement and sewer and paving materials.

Brookville, O.—Special.—H. H. Riley is in the market for cement.

Oil City, Pa.—Special.—C. F. Wm. Schubert, 17 Grove ave., desires to purchase steel, cast iron, lumber, cement and terra cotta.

Columbus, Ky.—Special.—Henry Gayle advises us that he is in the market for general building materials.

Kane, Pa.—Special.—W. L. Dykes, 507 Greene st., is in the market for cement.

Hoopeston, Ill.—Special.—Geo. Taylor Nicoson advises us that he is in the market for cement, lime and sand.

Olean, N. Y.—Special.—James Weatherell, 134 S. Berry st., is in the market for lime, cement and face brick.

Mound City, Ill.—Special.—G. J. Murphy, general manager Mound City Crystal Ice Mfg. & Coal Co., is in the market for cements, brick, etc.

San Antonio, Tex.—Special.—P. T. Shields, 1712 N. Olive st., advises us that he desires to purchase corrugated steel rods, 1-2, 3-4 and 1 inch, and steel I-beams, from 5 to 15 inches.

Deadwood, S. D.—Special.—James Hartgering is in the market for belting, etc.

Mauch Chunk, Pa.—Special.—John B. Duffy is in the market for cement, lime and brick.

Toronto, Ont.—Special.—Sexton & Co. 17 Richmond st., E., is in the market for brick, cement and wood.

Petersburg, Va.—Special.—Lewis O. Benson, 138 Harrison st., desires to purchase cement, paint and lumber.

Franklin, Pa.—Special.—Samuel Burgard, 225 Pacific st., is in the market for cement and colors.

Mineral Wells, Tex.—Special.—The South Mineral Wells Concrete Co., box 182, is in the market for Portland cement.

Baker City, Ore.—Special.—J. C. White, contr., is in the market for Portland cement and sewer pipe.

Deer Creek, Ill.—Special.—E. G. Walker advises us that he may want to purchase a carload of cement.

Pottsville, Pa.—Special.—Louis Miller is in the market for cement, etc.

Lancaster, O.—Special.—C. F. Junkerman, treasurer Lancaster Concrete Block & Paving Co., advises us that the company is in the market for cement, lime and plaster.

Fountain Inn, S. C.—Special.—T. E. Nelson advises us that he is just beginning in cement block work and wants to purchase two cars of cement.

Saginaw, Mich.—Special.—A. Selinas & Sons, room 6, Chase bldg., advise us that they are in the cement building business and reinforced construction.

Staples, Minn.—Special.—The Staples Lumber Co. advise us that they buy cement, plaster and brick.

Salt Lake City, Utah—Special.—Frank Doran, 1512 S. 6th st., is in the market for concrete reinforcements, metal studs, metal lathes, etc.

Stockton, Ill. — Special. — Schroeder Bros. are in the market for Portland cement.

Salt Lake City, Utah—Special.—A. and J. McDonald, 151 1-2 S. Main st., is in the market for brick for interior finish.

Butler, Ind.—Special.—John A. Fridenberger is in the market for cement.

Walla Walla, Wash.—Special.—The W. W. Brick & Stone Co., 507 W. Main st., is in the market for cement at moderate prices for hollow blocks. J. E. Myers, mgr.

New Ulm, Minn.—Special.—H. R. Stegeman, 1100 Center st., desires to purchase cement and broken stone.

Appleton, Minn.—Special.—A. G. Hancock desires to purchase cement.

Macon, Ga.—Special.—R. E. Clark, Napier Hights, is in the market for Portland cement and hard wall plaster of various kinds.

Old Forge, Pa.—Special.—T. B. Jones is in the market for cement.

Ottawa, Ont.—Special.—Thos. E. Farley, 145 McLeod st., is in the market for building materials.

Provo, Utah—Special.—Samuel Liddard, 89 N. 7th West, is in the market for cement and coloring.

Bayside, N. Y.—Special.—Geo. J. Hamill, of the Victory Concrete Construction Co., advises that his company is in the market for cement, sand, gravel, limestone, screening and marble chips.

Babylon, N. Y.—Special.—E. W. Howell desires to purchase cement.

Galena, O.—Special.—John A. Orwin, R. F. D. No. 1, is in the market for stone and cement.

Aurora, N. Y.—Special.—Chas. J. Defendorf & Co., 94 E. Geneva st., is in the market for Portland cement.

Findlay Lake, N. Y.—Special.—G. H. Fox desires to purchase cement.

Atlantic City, N. J.—Special.—John Murtland, 26 N. Texas ave., advises us that he is in the market for cement brick.

Langdon, N. D.—Special.—Laynes & Moore, sash and door mfrs., are in the market for all building materials.

Columbus, O.—Special.—Robert C. Kyle, president of the International Fence & Fireproofing Co., and Walter L. Dugan, chief engineer of the same company, have formed a partnership for handling all kinds of contractors' supplies and building materials, under the name of Kyle & Dugan, with offices at 282 E. Broad st. Attention will be given to special engineering and contracting in concrete steel construction. They announce, however, that their line of supplies is not yet full and invite catalogues and correspondence.

Denver, Colo.—Special.—The Kendrick Promotion Co. of the Crescent Land & Cement Co., 720 to 726 Exchange bldg., advise us that they are preparing to build a number of houses, to be sold on monthly payments. The houses are to be of three classes: (1) Small houses, built both economically and attractive, and as sanitary, fire and vermin proof as practicable; (2) more expensive houses; (3) houses to be still higher priced and more ornamental, one of which is for the use of the president of the company for a home. Names and addresses of firms best informed in cement construction are desired. W. F. Kendrick, prest.

Fargo, N. D.—Special.—Robt. Johnson, 202 2d st., N., advises us that he is in the market for cement.

Chicago, Ill.—Special.—P. L. McAllister, room 64, 265 LaSalle st., is in the market for cement, concrete, gravel and foundation material.

Valparaiso, Ind.—Special.—W. E. Harris, C. E., 803 E. Water st., advises us that he is in the market for blue print paper, etc.

Anderson, Ind.—Special.—E. S. McCandliss advises us that he is in the market for machinery and tools for brick streets and sewers.

Fernie, B. C.—Special.—Robert A. Kerr, box 293, is in the market for the latest improved cement block machine.

Macon, Ga.—Special.—R. E. Clark, Napier Hights, is in the market for machinery and tools for making cement single molding and a hollow block machine.

Ottawa, Ont.—Special.—Thos. E. Farley, 145 McLeod st., is in the market for cement block or brick machinery and carpenter tools.

Provo, Utah—Special.—Geo. J. Hamill, of the Victory Concrete Construction Co., advises us that he is in the market for concrete block and brick machinery sidewalk tools, tile and shingle machines, sill and lintel molds.

Galena, O.—Special.—John A. Orwin, R. F. D. No. 1, is in the market for machinery and tools for river masonry.

Aurora, N. Y.—Special.—Chas. J. Defendorf & Co., 94 E. Geneva st., desires to purchase a concrete mixer.

Findley Lake, N. Y.—Special.—G. H. Fox desires to purchase cement blocks and the machinery for making, and gas engines.

Wales, N. D.—Special.—The C. P. Getchell Co. is in the market for machinery and tools for making concrete blocks.

Washington, D. C.—Special.—Sealed bids are asked until Oct. 1 for furnishing the fire department with one wrecking and windlass wagon, with necessary tools and appurtenances thereto. H. B. F. MacFarland, chmn. Dist. Comrs.

Evanston, Wyo.—Special.—Geo. Dumford advises us that he is in the market for machinery and tools for general cement work.

Fairbury, Neb.—Special.—O. P. Collier advises us that he is in the market for a cement concrete mixer.

Macon, Miss.—Special.—J. P. Hunter is in the market for machinery and tools for all kinds of cement and concrete work and the manufacturing of cement.

Fargo, N. D.—Special.—Robt. Johnson, 802 2d st., N., is in the market for cement finishing tools.

Chicago, Ill.—Special.—P. L. McAllister, 65-262 LaSalle st., is in the market for concrete mixers.

Valparaiso, Ind.—Special.—W. E. Harris, C. E., 803 E. Water st., is in the market for surveying instruments and sundries.

Koosaqua, Ia.—Special.—The John Martin Bridge & Supply Co. advise us that they are in the market for a mixer and several molds. The company deals in cement and are contractors for all kinds of cement work.

New Ulm, Minn.—Special.—H. R. Stegeman, 1100 Center st., advises us that he is in the market for a concrete mixer and wheelbarrows.

Appleton, Minn.—Special.—A. G. Hancock is in the market for cement block machines.

Sioux City, Ia.—The Vaughn Mill & Construction Co., 5th and Morgan sts., are in the market for cement.

MISCELLANEOUS.

Byers, Tex.—The Clay County Bridge Co. has been incorporated by T. H. Harrison, C. P. Bobo and R. L. Ligon.

Vincennes, Ind.—Daniel H. Mason has been granted a patent on an excavating and loading machine.

New York City—Special.—The Goldschmidt Thermit Co. advises us that they are about to vacate their present manufacturing premises at 179 Christopher st., in this city, and have purchased ground and erected a large and commodious factory building, 165x75 feet, at the corner of Cornelison and Bishop sts., in Jersey City. The company's new factory is within easy reach of their downtown offices, 43 Exchange Place. The manufacturing plant will be reomved to the new location on or about Oct. 1.

The Chicago Pneumatic Tool Co. re-

ports the month of August to be the heaviest in the history of the organization, both in business booked and shipments made, the latter exceeding all previous monthly records, 15 per cent.

Owing to the rapidly increasing demands for their products throughout the southern states, the Chicago Pneumatic Tool Co. have opened an office in the Memphis Trust Bldg., room 1012, Memphis, Tenn., in charge of Mr. J. Francis Small.

The Decarie Mfg. Co., Minneapolis, Minn., have been awarded a contract for a complete garbage and refuse incinerating plant by the city of Winnipeg, Man. They have awarded a contract to the Wm. Bros. Boiler & Mfg. Co., of Minneapolis, for the contruction of two all-steel water-jacketed incinerators to be installed at Ocean Park and Santa Monica, Cal. This company has also placed an order with the American Bridge Co. of Minneapolis, Minn., for the construction of two steel buildings to house these incinerators.

Patents Concerning Cement and Its Uses.

810,393. Jan. 23, 1906. Railroad-Tie. Robert B. Campbell, Joliet, Ill.

810,494. Block Mold. John C. Miller, Jackson, Mich.

810,561. Reinforcing Device for Concrete Construction. Geo. L. Peabody, Pittsburg, Pa.

810,579. Mold for Making Concrete Fence Posts. Carl E. Stokoe, Grand Haven, Mich.

810,717. Truss for Cement Posts. Lee Clark, Garrison, Iowa.

810,748. Concrete Building Block. Winfield A. Haller, New Orleans, La., and Jas. W. Billingsley, Tivoli, N. Y.

810,876. Railroad Tie. Edward Murray, Chicago, Ill.

810,976. Jan. 30, 1906. Mold for Building Blocks. Wm. Porten, St. Paul, Minn.

810,988. Molding Machine. Harry C. Steele, Wm. Stenson and Fred J. Trout, Jacksonville, Fla.

811,022. Concrete Fence Post. Herrald S. Young, Beyrout, N. D.

811,032. Mold (for tanks, etc). Gustav A. Byor, Edgar, Neb.

811,080. Mold for Making Building Blocks. Harry Noah, Baxter, Iowa.

811,135. Concrete Mold. Frederic M. Emerson, Brookline, Mass.

811,243. Combined Derrick and Concrete Mixer. Jas. L. Parsons, Jr., Washington, D. C.

811,257. Bridge and Process of Making the Same. Joseph B. Strauss, Chicago, Ill.

811,300. Machine for Making Artificial Stone. Harry Z. Kline, Indianapolis, Ind.

811,313. Post. Jay D. Morse, Holbrook, Neb.

811,423. Press for Molding Cement or Plastic Blocks. Charles A. Meyers, Leipsic, O.

811,451. Fence Post. Delos A. Smith, Webberville, Mich.

811,491. Floor Structure. Jean Erath, Strassburg, Germany.

12,444. Reissue. Machine for Molding Concrete Bodies.

811,534. Feb. 6, 1906. Building Wall Construction. Wm. M. Akers and Benj. F. Huston, Decatur, Iowa.

811,560. Concrete Building Construction. Jas. B. Hinchman, Denver, Colo.

811,634. Building Block or Wall. Martin Haas, Kalamazoo Tp., Kalamazoo Co., Mich.

811,647. Block Molding Machine. Andrew J. Love, St. Louis, Mich.

811,675. Cement Fence Post Mold. Geo. H. Terry, Leslie, Mich.

811,902. Hydraulic Cement and Process of Making the Same. Carl D. Clark, Clifton, Ariz.

811,926. Reinforced Concrete. Edgar B. Jarvis, Toronto, Ont.

811,927. Reinforced Truss for Concrete. Edgar B. Jarvis, Toronto, Ont.

812,006. Apparatus for the Construction of Plastic Walls. David W. Bover, Waterloo, Iowa.

812,018. Method and Means for Railway Track Construction. Edward E. Clement, Washington, D. C.

812,108. Plastic Composition. Geo. C. Wyatt, Rome, Ga.

812,123. Machine for Molding Building Blocks. Alexander A. Forbes, Duluth, Minn.

812,223. Feb. 13, 1906. Concrete Pile, Pillar, Etc. Gustave L. Mouchel, London, Eng.

812,336. Machine for Forming Concrete Blocks. Emerson C. Glatfelter, New Philadelphia, O.

812,365. Mold for Concrete Walls. John L. Richardson, Bloomsburg, Pa.

812,369. Building Block. Frank M. Sawyer, Charlotte, N. C.

812,416. Press for Concrete Building Blocks. John A. Ferguson, Denver, Col.

812,454 and 812,455. Valve Bags. John Rogers, Cleveland, O.

812,498. Building Block. John A. Johnson, Winamac, Ind.

812,524. Concrete Railway Tie. Wm. H. Pruyn, Jr., Chicago, Ill.

812,615. Cement Block Molding Machine. Ritchie E. Teets, Toledo, O.

812,667. Building Block. Wm. D. Moore, Creston, Ia.

812,702. Core Cutter for Cement Block Machines. Jas. W. Stuart, Paris, Ill.

812,727. Building Construction. John S. Culley, Louisville, Ky.

812,767. Machine for Molding Cement Fence Posts. Bennett H. McMillan, Wm. C. Johnson and Frank M. Collord, Danville, Ill.

812,786. Heat Recuperator for Cement Kilns. Carleton Ellis, New York, N. Y.

812,834. Feb. 20, 1906. Oscillating Cement Kiln. Byron E. Eldred, Bronxville, N. Y.

813,060. Lifter for Lifting Hollow Blocks. Guilford D. Rowell, Appleton, Wis.

813,112. Cement Block Making Machine. Britton Poulson, Ft. Wayne, Ind.

813,117. Molding Machine. Clay M. Runyan, Elyria, O.

813,171. Process for the Production of Artificial Stone Plates. Carl Pohl, Budapest, Austria-Hungary.

813,205. Cross Tie and Means for Holding Track Rails Thereon. Edward A. Gilchrist, McKeesport, Pa.

813,303. Reinforcing Truss for Concrete. Edgar B. James, Toronto, Can.

813,334. Reinforced Concrete Curbing. Avila Thomas, Detroit, Mich.

813,338. Post. William W. Wilcox, Spencerport, N. Y.

813,439. Feb. 27, 1906. Mold. Chas. A. Landon, Findlay, O.

813,490. Cement Kiln. Thos A. Edison, Llewellyn Park, N. J.

813,540. Reinforced Concrete Construction. Chas. H. Black, Pettysville, Ind.

813,348. Building Construction. Geo. F. Fisher, North Tonawanda, N. Y.

813,572. Molding Apparatus. Willis H. McDowell, Auburn, Ind.

813,573. Machine for Manufacturing Concrete Building Blocks. Willis H. McDowell, Auburn, Ind.

813,590. Mold for Molding Tiles and Similar Articles. Frank M. Sawyer, Charlotte, N. C.
Brookline, Mass.

813,627. Cement Burning Process and Apparatus Therefor. Byron E. Eldred.

813,628. Process of Operating Gas Producers. Byron E. Eldred, Bronxville, N. Y.

813,629. Gas Producer. Carleton Ellis, New York, N. Y.

813,630. Heat Regenerator for Cement Kilns. Carleton Ellis, New York, N. Y.

813,721. Concrete Block Mold and Block. Chas. K. Lambie, Los Angeles, Cal.

813,803. Combined Steel and Concrete Beam. Julius Kahn, Detroit, Mich.

813,816. Fence Post. John C. McVey, Kansas City, Mo.

813,841. Method of Treating Cement and Cement Construction. Maximilian Toch, New York, N. Y.

813,901. Molding Machine. Parmenos G. Leming, Fred Eiklor and Chas. W. Grant, Urbana, Ill.

813,965. Production of Cement. Bernhard Grau. Kratzwieck, near Stettin, Germany.

814,022. March 6, 1906. Railroad Tie. Walter A. Collins, Penn's Manor, Pa.

814,154. Mold for Cement Building Walls. Alexander McCahon, St. Joseph, Mo.

814,304. Mold. Louis Landemann, Nevada, Mo.

814,308. Curb Conduit. Jas. C. Marriott, New Dorp, N. Y.

814,358. Plastic Block Molding Machine. Jas. J. Cox, Jackson, Mich.

814,585. Process of Supporting Forms Used in the Construction of Concrete and Other Masonry. Marshall W. Brown, Pittsburg, Pa.

814,657. Transformable Mold for Building Blocks. Harold A. Low, Lake City, Iowa.

814,742. March 13, 1906. Machine for Pressing Concrete Bricks. Henry H. Spears, Louisville, Ky.

814,765. Monolithic Building. Wells D. Butterfield, Detroit, Mich.

814,803. Concrete Mixing Machinery. Ernest L. Ransome, New York, N. Y.

814,959. Cylinder Pier Construction. Wm. H. Healy, San Francisco, Cal.

814,970. Artificial Stone Roofing Tile or Shingle. Frederick M. Leusch, Traer, Iowa.

814,973. Building Block. John Lovett, Martinsburg, W. Va.

815,080. Manufacture of Hydraulic Cement and Apparatus Therefor. Bernard Enright, Fordwick, Va.

815,089. Fence Post. Hubert E. Hillman, Huckleberry, O.

815,097. Building Block. Andrew Klay, Bluffton, O.

815,098. Cement Block Machine. Andrew Klay, Bluffton, O.

815,157. Tension Bar for Use in Concrete and the Like. John F. Golding, Washington, D. C.

815,364. March 20, 1906. Rail-Tie. Frank N. Mihills, Boston, Mass.

815,372. Machine for Molding Artificial Stone. Noyes F. Palmer, New York, N. Y.

815,409. Concrete and Metal Structure. Robert A. Cummings, Beaver, Pa.

815,447. Cistern Mold. Wm. H. Lucas, Newark, O.

815,576. Concrete Foundation for Scales. Geo. H. Birchard, Lincoln, Neb.

815,617, 815,618. Materials of Construction. Wm. Mueser, New York, N. Y.

815,619, 815,620. Concrete Steel Construction. Wm. Mueser, New York, N. Y.

815,641. Building Block. David A. Schoeneman, George, Iowa.

815,680. Apparatus for Making Cement. Rolla C. Carpenter, Ithaca, N. Y.

815,687. Retaining Wall for Reservoirs. Lewis K. Davis, Indianapolis, Ind.

815,705. Rotary Cement Kiln. Harry Hitzel, Alpha, N. J.

815,788. Fence Post. John A. Blake, Wolcott, Ind.

815,801. Building Material. Charles M. Depew and Hollis E. McCoy, San Francisco, Cal.

815,866. Retaining Wall or the Like. Edson M. Scofield, Philadelphia, Pa.

816,040. March 27, 1906. Apparatus for Lining Tunnels with Concrete. Jesse W. Reno, New York City.

816,156. Apparatus for Mixing and Making Plaster and Mortar. Albert Dellamore, Samuel Norton and Albert M. Norton, Los Angeles, Cal.

816,171. Artificial Stone Post or Column. Nicolas Michelena E. Inarra, Rentarida, Spain.

816,252. Artificial Stone Shingle. Orvey Price, Plainfield, N. J.

816,334. Tension Member for Composite Construction. Julius Kahn, Detroit, Mich.

816,389. Slag Cement and Method of Making the Same. Joseph A. Shinn, Pittsburg, Pa.

816,408. Block Molding Machine. Gilbert Wilhelm, Traverse City, Mich.

816,438. Cement Block Machine. Clarence F. Davis, Sherwood, Mich.

816,488. Cement Block Molding Machine. Frank F. Martin, Beloit, Wis.

816,542. Machine for Manufacturing Solid Concrete Building Blocks or Veneer Blocks. Robert Edmondson, South Bend, Ind.

12,467, reissue. Building Construction. Orvey Price, Plainfield, N. J.

816,613. April 3, 1906. Machine for Making Cement Blocks. Emanuel and Jas. O. Silva, Springfield, Ill.

816,628. Electric Transmission Pole. John L. Weller, St. Catharines, Can.

816,715. Cement Fence Post. Clarence Dodd, Waterville, O.

816,753. Cement Burning Furnace. Willoughby E. Snyder, Nazareth, Pa.

816,800. Railway Cross Tie. Julius Kahn, Detroit, Mich.

816,831. Molding Machine. David D. Tracy and Hugh J. Keenan, Jackson, Mich.

817,017. Cement Fence Post. John A. Stransky, Pukwana, S. D.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Bluffton, Ind.—City council has purchased an asphalt plant from Hetherington & Berner, of Indianapolis, for $6,750, ordered a carload of California asphalt, and other tools, including a steam roller, preparatory to repairing its own asphalt streets.

Tacoma, Wash.—Judge Hanford, in the federal court, dissolved the injunction against the Independent Asphalt Paving Co., Sept. 13, on agrement of the counsel, prohibiting it from carrying out its contract with the city to pave Commerce st., between S. 7th and 9th sts. Litigation following a clash between the Tacoma Railway & Power Co., and the Pacific Traction Co., both of which claimed a franchise to lay tracks on the street, tied up the paving company. The paving of the street will now proceed.

CONTEMPLATED WORK.

Ripon, Wis.—Macadam paving is desired.

Baraboo, Wis.—Macadam paving is proposed.

Gladstone, Mich.—Concrete sidewalks are proposed.

Fond du Lac, Wis.—Park ave., from Merrill to 4th sts., will be paved.

Belle Plaine, Ia.—This city contemplates paving 12th st. next year.

Menasha, Wis.—About 1-2 mile of cement sidewalks have been ordered.

Racine, Wis.—Brick paving and cement walks are desired for Freeman court.

Packwood, Ia.—Cement crossings have been authorized on Main st. at 1st st.

Tacoma, Wash.—Extensive street improvements are contemplated for next year.

Columbus, Ga.—A resolution has been adopted to pave Warren st. with bitulithic.

Woodsfield, O.—Nearly all of the principal streets of this city will be paved.

Newton, Ia.—The paving of the alleys around the public square is proposed.

Superior, Wis.—Macadam paving is proposed on Grand ave., from Belknap to 18th.

Reading, Pa.—Ordinances have been passed for paving several streets with brick.

Dallas, Tex.—The question of paving Merlin and Dawson sts. is being discussed.

Port Tampa, Fla.—Will vote on the issue of bonds for constructing a boulevard.

Austin, Minn.—Brick paving is contemplated for Water st., from Railroad to Chatham.

Waterloo, Ia.—Asphalt paving is contemplated for Commercial and 7th sts. Mayor Rector.

Toledo, O.—Council has voted to pave Central ave., in front of the Pope Motor Co.'s works.

Aurora, Ill.—A petition is being circulated asking for 9 blocks of asphalt paving on North ave.

Washburn, Wis.—A cement sidewalk is contemplated on Bayfield st., from Central to 1st ave., W.

St. Joseph, Mich.—A resolution has been passed to pave certain streets. Harry L. Murphy, cy. clk.

Alexandria, La.—An ordinance has been adopted and bids authorized for paving 3d st. with gravel.

Indianapolis, Ind.—The Park Board is discussing the question of enlarging the Fall Creek boulevard.

Lincoln, Neb.—The resurfacing of the streets in the business district with asphalt is contemplated.

Jackson, Miss.—City council has under consideration several petitions for paving, involving about 5 miles.

Hastings, Mich.—Several blocks of brick paving is contemplated for next spring. Dr. G. W. Lowry, mayor.

Racine, Wis.—The board of public works contemplates the paving of 25 and grading of 19 streets next year.

Melrose Park, Ill.—The village board has decided to expend $16,000 for asphalt paving and cement sidewalks.

Menominee, Mich.—Brick paving is contemplated for Main and State sts. next year, at a cost of $67,392.05.

Des Moines, Ia.—Council has authorized the paving of Locust st., from 4th to 8th, with creosoted wood blocks.

Jeffersonville, Ind.—Dr. E. N. Flynn, the new mayor here, is in favor of substituting brick paving for macadam.

St. Clairsville, O.—Council will revise the specifications for paving Main st. with brick, and will readvertise for bids.

Harlem, Ill.—The village board has voted to expend $135,000 for constructing asphalt streets and cement walks next spring.

Woodland, Cal.—An ordinance has been passed, calling a bond election to be held Oct. 2 to issue bonds for street improvements.

Cleveland, O.—The question of issuing $200,000 bonds for the completion of the West Side boulevard will be voted on in November.

Buffalo, N. Y.—The street committee has decided to recommend the paving of Ellicott, Lewis, Mulberry and North sts. Koons ave. and Whitney Place.

Dallas, Tex.—The city engineer has been authorized to ask for bids for graveling Kentucky st. and paving Live Oak ave. with hard crushed rock.

Madisonville, O.—A resolution has been passed to macadamize Center st., from Moore st. to the B. & O. tracks, and construct cement curbing and gutters.

Fremont, Neb.—The Commercial Club is circulating a petition asking city council to call a special election to vote $40,000 for paving the intersections of streets.

Bloomington, Ind.—City Engineer Hanna has been directed to prepare plans and specifications for vitrified brick paving on Kirkwood and College aves., and Walnut, 4th, 3d, 6th and Morton sts.

Appleton, Wis.—The city clerk has been directed to correspond with the city engineers of Boston, Kansas City and St.

Paul regarding the grade on which it is safe to place creosoted wood blocks.

Knoxville, Tenn.—A petition is being circulated asking that Oak ave., from Oak ave. bridge to Deaderick ave., be paved. Paving is also desired by the property owners in various other parts of the city.

Columbia, S. C.—Members of city council are preparing their estimates on expenditures to be made next year. They are divided on the proposition of vitrified brick or bitulithic pavements, and some of them favor granite blocks.

Indianapolis, Ind.—Specifications have been approved for paving Butler ave., in Irvington, with bitu-mineral. Park ave., from 21st st. to Sutherland ave., will be paved with asphalt. Ordinances have been passed providing for asphalt, brick and wooden block paving on a number of streets.

Lincoln, Ill.—Water st., from Union to Keokuk sts., will be paved. Mayor King.

Grand Rapids, Mich.—Sealed bids are asked until Oct. 8 for $200,000 bonds for improving streets. John L. Boer, cy. clk.

Athens, O.—An ordinance has been passed to pave Mill st., from College st. to B. & O. S. W. tracks, with brick or block. W. B. Golden, clk.

St. Louis, Mo.—Plans for King's Highway boulevard have been completed and submitted to the board of public improvements.

Columbus, O.—A resolution has been passed to pave Fulton st., from High to Front sts., with asphalt, brick or block. Also, to construct artificial stone or brick sidewalks on 1st ave., from High st. to Pennsylvania ave.

CONTRACTS TO BE LET.

Green Bay, Wis.—Bids are asked until Oct. 12 for grading S. Broadway st. Cy. clk.

Cincinnati, O.—Bids are asked until Oct. 8 for improving Werk road. M. J. Keefe, clk. B. P. S.

Salem, Ind.—Bids are asked until 1 p. m., Oct. 1, for constructing roads. Frank E. Morris, co. audt.

Valparaiso, Ind.—Bids are asked until Oct. 1 for building gravel roads. Stephen B. Corboy, co. audt.

Waterloo, Ia.—Bids are asked until Oct. 8 for building 7,560 feet of cement walks. Mayor Rector.

Decatur, Ind.—Bids are asked until Oct. 5 for constructing macadam roads. C. D. Lewton, co. audt.

Omaha, Neb.—Bids are asked until Oct. 2 for paving and curbing Charles and Lake sts. Dan B. Butler, cy. clk.

New Orleans, La.—Bids are asked until Oct. 1 for paving Walnut st. with asphalt. Chas. R. Kennedy, cy. compt.

Ramsey, N. J.—Bids are asked until Oct. 6 for constructing a stone road. Chas. F. Schneider, clk. Hohokus twp.

Omaha, Neb.—Bids are asked until Oct. 10 for grading 19,000 cu. yds. on Calhoun road. D. M. Haverly, co. clk.

Manassas, Va.—Sealed bids are asked until Oct. 10 for macadamizing the streets. O. E. Newman, chmn. constr. com.

Bloomington, Ind.—Bids are asked until Oct. 3 for constructing 43,395 feet of pikes. Samuel M. Kerr, co. audt.

Appleton, Wis.—Bids are asked until Oct. 3 for paving Lake st. bridge with tar macadam. E. L. Williams, cy. clk.

Cleveland, O.—Sealed bids are asked until Oct. 3 for paving an alley with brick. W. J. Springborn, prest. B. P. S.

Grand Rapids, Mich.—Bids are asked until Oct. 31 for constructing 1 mile of roadway in Byron twp. Michael J. O'Meara, twp. clk.

Cincinnati, O.—Bids are asked until Oct. 12 for placing crushed stone and gravel on certain roads. Christian Bardes, prest. co. comrs.

Rockville, Ind.—Bids are asked until Oct. 1 and 4 for constructing gravel roads. T. A. Garrard, chmn. co. comrs.; Henry Grubb, co. audt.

Canton, O.—Bids are asked until Oct. 5 for 8,300 sq. yds. of brick paving, 3,000 lin. ft. straight curbing, sewers, etc. B. . . Hunt, clk. B. P. S.

Atlanta, Ga.—Bids are asked until Oct. 1 for resurfacing 33,000 sq. yds. of Peachtree st. with asphalt or bitulithic. R. M. Clayton, cy. engr.

Jacksonville, Fla.—Bids are asked until 3 p. m., Oct. 1, for paving certain streets with brick or blocks and macadam. Philip Prioleau, cy. engr.

Egmont, Fla.—Bids are asked until 7 p. m., Oct. 1, for constructing brick roads and concrete walks at this post. Lieut. R. H. Jordan, constr. Q. M.

Chicago, Ill.—Bids are asked until Oct. 8 for changes in the driveway at the U. S. postoffice here. James Knox Taylor, supv. arch., Washington, D. C.

Ottumwa, Ia.—Bids are asked until Oct. 1 for paving 4th and College sts. with asphalt, and constructing artificial stone combined curb and gutter. Cy. clk.

Clinton, Tenn.—Bids are asked until 1 p. m., Oct. 1, for constructing 3 1-10 miles of pike road, from this city to Briceville. J. K. P. Wallace, chmn. co. pike comn.

Roanoke, Va.—Sealed bids are asked until Oct. 5 for grading, macadamizing and constructing granolithic curb and gutters on certain streets. W. E. Thomas, clk. coun.

Perth Amboy, N. J.—Bids are asked until 8:30 p. m., Oct. 1, for 6,000 sq. yds. of vitrified brick paving and 2,500 lin. ft. of new curb, on Maple st. W. H. Fullerton, st. comr.

Cleveland, O.—Bids are asked until Oct. 6 for completing the Schaaf road improvement, and for earth fill of complete embankment on Miles ave., No. 2 impvt. A. B. Lee, co. engr.

Camden, N. J.—Sealed bids are asked until Oct. 10 for macadamizing 3 1-3 miles of public road from Haddonfield to Coffins Corner. Alfred L. Sayers, dir. freeholders; J. J. Albertsen, co. engr.

Atlantic City, N. J.—Bids are asked until Oct. 3 for constructing a gravel road, known as the Hammond and Atsion road, 6.4 miles in length. F. Fraley Doughty, dir. freeholder; E. D. Rightmire, co. engr.

Montgomery, Ala.—Sealed bids are asked until 12 m., Oct. 1, for paving Caroline st., from Clayton to Mildred, with brick, bitulithic, asphalt or gravel; paving sidewalk of Pelham st., from Union to Hillaird, with Hexagon tile or Schillinger pavement. R. S. Williams, cy. treas.

Indianapolis, Ind.—Sealed bids are asked until Oct. 1 for graveling Brightwood ave., from 28th to 30th sts.; paving North st., from Noble to Pine sts., with creosoted wooden blocks; 24th st., from Central to College ave., with asphalt; constructing cement walks on Woodlawn ave., 22d, 17th, Harris and Blake sts. and Whittier Place. Joseph T. Elliott, chmn. B. P. W.

Wauseon, O.—Bids are asked until Oct. 8 for paving N. Fulton st. Chas. Hodges, clk.

Byron Center, Mich.—Bids are asked until Oct. 31 for constructing 1 mile of roadway. Mich. J. O'Meara, cy. clk.

Connersville, Ind.—Bids are asked until Oct. 4 for paving Western ave. with brick on sand and gravel. Jacob S. Clouds, cy. clk.

Winnetka, Ill.—Bids are asked until Oct. 3 for macadam paving. Edw. C. Kohler, prest. bd. local impvts.; Frank A. Windes, vil. engr.

CONTRACTS AWARDED.

Lafayette, Ind.—The contract for improving 8th st. was awarded, Sept. 5, to Wm. M. Jackson.

Kansas City, Mo.—The Kansas Bitulithic Co. will construct 18,000 sq. yds. of bitulithic.

McKenzie, Tenn.—The contract for constructing concrete walks was awarded to Costen, Moore & Co.

Cortland, N. Y.—The contract for constructing the Hartford state road was awarded to John Weber & Sons, of New York City.

St. Boniface, Man.—The contract for asphalt block paving on Provencher ave., from Rue St. Jean Baptiste to the Seine river, 7,270 sq. yds., was awarded to Langley & Cook, of Walkerville, Ont., at $3.57 a sq. yd.

Eggleston, Ind.—Rankin & Eggleston secured the contract for paving alleys with Metropolitan block, for $11,693.38.

Chicago, Ill.—The contract for resurfacing the drives in Humboldt and Douglas parks was awarded to the R. F. Conway Co.

Pontiac, Ill.—The contract for constructing 10 miles of cement sidewalks was awarded to A. D. Thompson, of Peoria, for $28,000.

Hillsboro, Ill.—A contract for street paving was awarded, Sept. 12, to C. D. Fry & Co., of New Castle, Ind., for $28,000.

Troy, N. Y.—Thos. H. Karr was awarded the contract for constructing the East Nassau-Brainard Rensselaer road, for $33,950.

Westfield, N. J.—The contract for 36,500 ft. of bluestone flagging was awarded to J. W. Manhattan, of Plainfield, N. J., for $8,223.

Ottawa, Ill.—Henry L. Hossack was awarded the contract for curbing and 2,080 sq. yds. of brick paving on Main st., for $4,436.95.

Beloit, Wis.—The contract for paving a large number of streets was awarded to A. E. Rutledge, of Rockford, for $27,602.40.

Albany, N. Y.—The contracts for paving 6th ave. and Jacobs st. were awarded to E. H. McKenna. Reese-Hammond brick will be used.

Galveston, Tex.—Kelso & Vautrin, 205 Tremont st., secured the contract for 10 blocks of vitrified street paving for $27,000.

New Castle, Ind.—James Garvey was awarded the contract for improving Hiram st. and building a concrete retaining wall in Indiana st.

Salt Lake City, Utah—P. J. Moran was awarded the contract for macadamizing 12th East st., from 2d to 3d South sts., Sept. 5, for $5,614.

Boston, Mass.—Warren Bros. Co. has been awarded an additional contract of 4,676 sq. yds. of bitulithic.

Baltimore, Md.—The contract for paving York road with Belgian blocks was awarded, Sept. 17, to the Gatz Construction Co., for $159,913.

Lake Forest, Ill.—The contract for constructing 4,864 ft. of macadam paving was awarded, Sept. 12, to A. E. Price, of Chicago, for $15,756.

Washington, D. C.—The contract for establishing a permanent grade on Connecticut ave. was awarded, Sept. 8, to C. B. Mullin, for $19,308.

Donaldsonville, La.—The Southern Bitulithic Co. was awarded the contract for paving Mississippi st. and Railroad ave., for $58,673.45.

Dallas, Tex.—An additional contract for 2,575 sq. yds. of bitulithic has been awarded the Texas Bitulithic Co.

Atchison, Kas.—The Atchison Crushed Stone Co. was awarded a contract, Sept. 15, for paving Kearney st. with vitrified brick, for $2,268.

Tallulah, La.—The contract for 1,200 lin. ft. of curbing around the court house was awarded, Sept. 10, to C. W. Curphey, of Vicksburg, Miss.

Los Angeles, Cal.—The Barber Asphalt Paving Co. was awarded the contract for paving San Pedro st., from 5th to Jefferson, with asphalt, for $94,942.

Stroudsburg, Pa.—A contract has been awarded to the Frazier Construction Co. to build a macadam road from Pocono Summit to Pacono Inn, 1 3-4 miles, for $11,500.

Toronto, Ont.—The Warren Bituminous Paving Co. of Toronto, Ont., will lay in that city 865 additional sq. yds. of bitulithic.

Shamokin, Pa.—The contract for constructing 8 miles of macadamized roads from here to Paxinos was awarded to the Shamokin Construction Co., for $47,059.

Valparaiso, Ind.—Contracts for constructing roads were awarded, Sept. 3, as follows: Conover & Tabor, $18,990; W. B. Hutchinson, of Michigan City, $47,977.

Perth Amboy, N. J.—The Standard Bitulithic Co. of New York City has been awarded a contract for 25,000 sq. yds. of bitulithic.

Scranton, Pa.—A contract for 20,000 sq. yds. in Pittston ave. has been awarded the Standard Bitulithic Co. of New York City.

New Brunswick, N. J.—A contract for 18,300 sq. yds. of bitulithic has been awarded the Standard Bitulithic Co. of New York City.

Columbus, Ga.—A contract for 3,800 additional sq. yds. of bitulithic has been awarded the Southern Bitulithic Co. of Nashville, Tenn.

Portland, Ore.—Warren Construction Co. of Portland, Ore., has been awarded an additional contract for 21,164 sq. yds. of bitulithic.

Wheaton, Ill.—The contract for constructing 3 1-2 miles of macadam streets and 8 miles of curbing was awarded to the Foulkes & Forbes Co., of Terre Haute, Ind., for $60,000.

St. Boniface, Man.—A contract for 18,273 sq. yds. of bitulithic has been awarded the Warren Bituminous Paving Co. of Toronto, Ont.

Decatur, Ill.—The Granite Bituminous Paving Co. of St. Louis, Mo., will construct 25,751 sq. yds. of bitulithic in Decatur, Ill.

Indianapolis, Ind.—The contract for paving 20th st., from Talbot ave. to Bellefontaine st., with wooden block was awarded to the Union Asphaltic Construction Co., at $4.75 a ft.

Newark, N. J.—An additional contract for 28,700 sq. yds. of bitulithic has been awarded the Standard Bitulithic Co. of New York City.

Baltimore, Md.—Contracts for 10,351 sq. yds. of bitulithic pavement in Oak and 27th sts. have been awarded to the Warren Bros. Co. of Boston.

St. Catharines, Ont.—An additional contract for 800 sq. yds. of bitulithic has been awarded the Warren Bituminous Paving Co. of Toronto, Ont.

Allegheny, Pa.—Paving, grading and sewer contracts were divided, Sept. 6, between M. O. Herron, Ott Bros., H. C. Howard and the International Construction Co., aggregating $47,684.

Toronto, Ont.—Warren Bituminous Paving Co. of Toronto, Ont., has received contract for 1,400 sq. yds. of bitulithic in addition to that previously awarded.

Covington, Ky.—The Kirchner Construction Co. was awarded the contract for resurfacing 4th, Pike and Scott sts. and Madison ave. and Park Place with asphalt at $1.25 a sq. yd. for Bermuda asphalt.

Hazleton, Pa.—A contract for 540 sq. yds. of bitulithic, in addition to that previously announced, has been awarded to the Standard Bitulithic Co. of New York City.

Vicksburg, Miss.—Special.—J. S. Allen, cons. engr., advises us that the contract for paving Washington st. was awarded, Sept. 3, to the Southern Paving & Construction Co., for $67,657. Vitrified brick will be the material.

Somers, Conn.—The contract for constructing 2 sections of road here was awarded to Amos Bridge, of Hazardville. The contract provides for 1,250 ft. of macadam road at $1.59 a lin. ft. and 4,634 ft. of gravel road at 87 1-2 cts. a lin. ft.

Spokane, Wash.—Contracts for street improvements were awarded, Sept. 12, as follows: Mitchell Bros., grading, curbing and parking Chandler st., $2,200; Nettie ave., $528. Root & Biegle, sidewalks on Chandler st., $1,125; Nettie ave., $865.

Dunkirk, N. Y.—Paving contracts have been awarded as follows: 5th st., asphalt, on 4-in. concrete, Mayer Bros., of Erie, Pa., $26,701.21; Wright st., $5,362.36; and Railroad ave., $13,845.82, R. C. Ruthven, of Buffalo, using Jamestown shale brick on 4-in. base.

St. Louis, Mo.—The Granite Bituminous Paving Co. has been awarded a contract for 60,415 sq. yds. of bitulithic. With the completion of this contract, St. Louis will have approximately 25 miles of bitulithic streets.

Hartford, Conn.—Contracts for paving sections of Maple, Franklin and Albany aves. have been awarded as follows: Sternberg & Son, West Hartford, Albany ave., 1,571 ft., $2.90 a ft., or $4,555.59; Franklin ave., 1,340 ft., $2.90 or $3,886. F. T. Ley Co., Springfield, Mass., Maple ave., 1,546 ft., $3 a ft., or $4,638.

Baltimore, Md.—Paving contracts have been awarded as follows: Whitelock st., from Mount Royal Terrace to Linden ave., bitulithic, Warren Bros. Co., $23,079.25; Ducatel st., from Eutaw st. to Linden ave., vitrified brick, J. F. Gantz & Co., $3,830.25; 20th st., from Charles to St. Paul sts., asphalt blocks, Maryland Pavement Co., $4,461.85.

Baltimore, Md.—Following the decision of the Maryland court of appeals, sustaining the commissioners for opening streets in their right to select the paving material for any particular street, a contract for 26,025 sq. yds. of bitulithic has been awarded the Warren Bros. Co. of Boston, Mass.

Kansas City, Mo.—The Barber Asphalt Paving Co. has been awarded contracts as follows: Belleview st., from 39th st. to Westport, $1.56 a sq. yd.; resurfacing 15th st. from Grand to Campbell, $1.21, and from Campbell to Virginia, $1.15. The company was also awarded contracts for paving a number of streets at $1.65 a sq. yd., and for repairs at 88 1-2 cents a sq. yd.

Chickasha, I. T.—The contract for paving Chickasha ave. and 3d st., with storm sewers on same, was awarded to the Cleveland-Trinidad Paving Co., of Cleveland, O., for $49,103. Other bids submitted were as follows: Barber Asphalt Paving Co., $49,115; Kansas Bitulithic Co., Kansas City, Mo. (2 bids), $59,369 and $56,669; Municipal Paving Co., Dallas, Tex., $56,750, and W. W. Cook & Son, Muskogee, $54,097.

Chicago, Ill.—The Barber Asphalt Paving Co. was awarded the contract for paving Berkeley ave. with asphalt, at $1.48 a sq. yd., and the R. F. Conway Co. the contract for asphalt paving on 63d st., at $2.10 a sq. yd. The R. F. Conway Co. was also awarded the contract for paving Market st., from Randolph to Washington, with granite brick, for $15,279. The Standard Paving Co. secured the contract for paving Halsted st., from Archer ave. to 39th st., with granite blocks, for $100,796.

Boston, Mass.—Bids for constructing state roads were submitted Sept. 11, as follows: Mansfield, Mass., Edward J. Rourke, $3,861; R. F. Hudson, $4,128. Pittsfield, Mass., Harman & Bro., $4,046. Holliston, Mass., R. F. Hudson, $5,481; W. H. Mague Co., $4,870; Worcester Broken Stone Co., $5,359. Tewksbury, Mass., R. F. Hudson, $6,800; Fred E. Ellis, $6,752. Huntington, Mass., Amos D. Bridge, $4,731; W. L. Camarco, $4,391; Lane Construction Corporation, Conn., $4,045.

Woodbridge, Conn.—The contract for constructing 2,375 ft. of macadam road was awarded to W. C. Tryon, of Meriden, for $4,132.50.

Kirkwood, Mo.—The contract for reconstructing the macadam paving on Main st. was awarded to Henry Winter, Jr., and Webster ave. to Doer Bros.

Springfield, Ill.—The contract for paving S. Grand ave., between 6th and Walnut sts., with asphalt was awarded Sept. 19 to the Barber Asphalt Paving Co., at $1.87 1-2 a sq. yd. for paving and 10 cts. for excavations.

Columbus, O.—A. G. Pugh was awarded contracts, Sept. 17, for paving Cherry and Bolivar sts. with asphaltic concrete, a new material here, for $5,069.50 and $15,382 respectively. Other contracts awarded were as follows: Repair of Broad st., from Starling to Central, with Athens block, to the Buckeye Engineering and Construction Co., $11,345; alley north of Buttles ave., Front to Dennison, with Athens block, to the Wm. H. Luchtenberg Co., $6,901.40; Souder ave., Town to Sullivant, with Athens block, to Wm. E. Schwartz, $5,650.52; Cleveland ave., Long to Buckingham, with block, Frank J. Fisher, $2,121.50; 13th ave., High to Indianaola, with Trinidad asphalt, Barber Asphalt Paving Co., $8,978.92; 12th ave., High to Summit, with El Oso asphalt, A. G. Pugh, $17,581.20; 6th st., Innis ave. south line of Linton & McLaren's add., with Nelsonville block, D. E. Sullivan, $4,922.50.

SEWERS.

Waukegan, Ill.—In its answer filed in the United States circuit court, Sept. 7, by the Corn Products Refining Co. to a bill for injunction filed against the company some time ago, alleging that the

company placed organic matter in the lake until the air was filled with noisome odors and the water made unfit for bathing or domestic purposes, it denies the charge, and alleges that if any one is responsible for the pollution of the like, it is the city of Waukegan, which empties thousands of gallons of sewage into the lake near the company's plant daily.

CONTEMPLATED WORK.

Austin, Minn.—A sewer is contemplated on Ash st.

Ames, Ia.—Sewers on several streets are proposed.

Hallock, Minn.—A new sewerage system is contemplated.

Buhl, Minn.—Village council has plans for a sewerage system.

De Soto, Mo.—About 4 miles of sewers are contemplated. Cy. clk.

Naugatuck, Conn.—Plans are being prepared for a sewer on S. Water st.

DuQuoin, Ill.—A sewerage system is contemplated. Joe Cook, cy. clk.

Plainville, Conn.—Surveys are being completed for a sewerage system.

Estherville, Ia.—A 12-in. sewer is proposed on S. 9th and N. 7th sts.

Hibbing, Minn.—Bids will be asked soon for constructing a sewerage system.

Bainbridge, Ga.—Voted to issue bonds for constructing a sewer system.

Ottumwa, Ia.—Council has authorized the construction of 5,360 ft. of sewers.

Sioux Falls, S. D.—A septic tank at the high school is under consideration.

Woodland, Cal.—Will vote in October on issue of bonds for sewer extension.

Shawnee, Ok.—The estimated cost of the proposed sewerage system is about $150,000.

Norman, Ok.—Will vote on issue of $20,000 bonds for constructing a sewerage system.

Norfolk, Neb.—The question of constructing a sewerage system is under consideration.

Scottdale, Pa.—Will vote on issue of $12,000 bonds for completing the sewerage system.

Oakland, Cal.—Voted to issue $586,000 bonds for constructing the outfall sewer system.

Henderson, Ky.—Will vote in November on issue of $200,000 bonds for constructing sewers.

Dundee, Ill.—The question of a sewerage system for West Dundee is still under consideration.

St. Peter, Minn.—The street com. of council will recommend the construction of a main sewer.

Chardon, O.—A resolution has been passed to build a sewer in Main st. alley. H. C. Bickle, mayor.

Red Deer, Alta—Willis Chipman, of Toronto, is designing engineer for the proposed sewer system here.

Fairhaven, Mass.—Voted to build an extension of the Shone system of sewers in Bridge st. Town Clk. Swift.

Pittsburg, Pa.—Ordinances have been approved authorizing the issue of $70,000 bonds for sewer extensions.

Chicago Heights, Ill.—Plans are being made for a sewer and a storm water sewer system. John Gravelot, cy. clk.

Carbondale, Ill.—Bids will be asked for 3,000 ft. 10-in. vitrified tile pipe sewer. F. M. Caldwell, cy. clk.

Des Moines, Ia.—Council voted to construct a 6-mile sewer system for northeast Des Moines, at a cost of $45,000.

Winchester, Ky.—Will vote in November on the issue of $40,000 bonds for constructing a sanitary sewerage system.

Louisville, Ky.—Will vote in November on issue of $4,000,000 bonds for constructing a comprehensive sewerage system.

Kokomo, Ind.—County council has appropriated $5,500 for the erection of a hospital and sewerage system at the county farm.

San Francisco, Cal.—Plans are being prepared by Thos. Woodward, cy. engr., for sewer work on 11th, Mission, 7th, 5th and 18th sts.

Wellington, Kas.—Special.—O. T. Reece, cy. engr., says city will vote at a special election on the issue of bonds for constructing sewers.

Millville, N. J.—The state sewerage commission has notified council that it will be necessary for this city to erect a sewage disposal plant.

Cairo, Ill.—Plans and specifications are being made for constructing a main sewer of reinforced concrete and a branch sewer. R. A. Hatcher, cy. clk.

York, Pa.—Council has passed an ordinance appropriating $550,000 for completing the present sewerage system and disposal plant and paving certain streets.

Grand Rapids, Mich.—Sealed bids will be received Oct. 8 for the purchase of street improvement and sewer construction bonds. John L. Boer, cy. clk.

Batesville, Ark.—Commissioners John Q. Wolf, F. D. Fulkerson and M. C. Weaver have received the plans for the proposed sewer district in this city.

Waterloo, Ia.—Plans and specifications are being made for a sanitary vitrified tile or concrete sewer pipe system for East Waterloo. C. T. Wilson, engr.

Wynne, Ark.—City council has appointed Councilmen Daltroff, Moore and Scott a committee to make inquiries regarding septic tank sewer systems being installed in many cities.

Ansonia, Conn.—Maps and profiles of the streets of this city, in connection with the proposed sewerage system, will be prepared by Chas. H. Nichols, of New Haven. Mayor Farrell.

Aylmer, Que.—City council approved, Sept. 11, plans and specifications for a sewerage system, calling for 2 outlets, 21,050 ft. 9 to 20 in. pipe, 64 catch basins, 778 junctions, 79 manholes and trenches. M. Sayer, mayor.

Harrisburg, Pa.—This city will probably petition the state board of health for permission to extend the sewerage system by the construction of additional sewers, the creek improvement and the river dam. M. B. Cowden, cy. engr.

Reading, Pa.—S. J. Lewis, chemist with Hering & Fuller, of New York City, who made the tests at the sewage disposal plant of the system installed by O. M. Weand, will be retained by this city as engineer in charge of construction.

CONTRACTS TO BE LET.

Brookville, Ind.—Bids are asked until Oct. 8 for constructing a public drain. Co. comrs.

Mediapolis, Ia.—Bids are asked until Oct. 3 for constructing 2,500 ft. of sewer. Cy. clk.

Iowa Falls, Ia.—Bids are asked until Oct. 1 for constructing 5 blocks of sewers. Cy. clk.

Hudson, Wis.—Bids are asked until Oct. 1 for building a sewer on 3d st. A. Karras, cy. clk.

Two Rivers, Wis.—Bids are asked until 7:30 p. m., Oct. 1, for building sewers on Williams st. B. P. W.

Jamestown, N. D.—Bids are asked until Oct. 1 for constructing a sewerage system. John G. Bensel, cy. audt.

Winnetka, Ill.—Bids are asked until Oct. 3 for constructing tile culverts, drains, etc. Frank A. Windes, vil. engr.

Washington, D. C.—Sealed bids are asked until Oct. 2 for constructing sewers. H. B. F. McFarland, chmn. Dist. Comrs.

Paris, Ill.—Bids are asked until Oct. 1 for constructing 1,500 ft. 10-in. tile pipe sewer in Elizabeth st. Cy. engr.

Fayetteville, N. C.—Sealed bids are asked until Oct. 3 for constructing a sewerage system. H. L. Horne, chmn. pub. wks. comn.

Ft. Dodge, Ia.—Bids are asked until Oct. 8 for 585 ft. storm sewer and 6 catch basins on 18th st. C. H. Reynolds, cy. engr.

Cleveland, O.—Sealed bids are asked until Oct. 4 for constructing sewers in W. 117th st. and Lorain ave. W. J. Springborn, prest. B. P. S.

Washington, D. C.—Bids are asked until Oct. 11 for drainage for the Walter Reed Army General Hospital. Capt. A. W. Butt, Q. M.

Mare Island, Cal.—Bids are asked until 10 a. m., Oct. 2, for furnishing sewer and c. i. pipe. H. T. B. Harris, Paym. genl., Washington, D. C.

Yankton, S. D.—Bids are asked until Oct. 15 for constructing 10,000 ft. of pipe sewers, manholes, flushtanks, etc. A. D. Russell, cy. clk.

Willoughby, O.—Bids are asked until Oct. 8 for constructing a main line and trunk sewer for a system of sanitary sewerage. C. C. Jankins, vil. clk.

Charleston, Ill.—Bids are asked until Oct. 15 for constructing 1,500 lin. ft. of 24-in. tile sewer in 4th st. C. W. Roberts, cy. clk.; W. B. Watson, cy. engr.

Mt. Vernon, Ill.—Bids are asked until Oct. 1 for building 1-2 miles vitrified pipe sewer and 7 manholes and covers. G. E. Green, cy. clk.; C. B. Wells, cy. engr.

Montgomery, Ala.—Sealed bids are asked until 12 m., Oct. 1, for constructing storm water sewers on High, Decatur and Bainbridge sts. R. S. Williams, cy. treas.

Canton, O.—Bids are asked until Oct. 5 for constructing 2,000 ft. pipe and storm sewers and 10 catch basins. Also, 3,600 ft. sewers and 8 manholes. B. F. Faust, clk. B. P. S.

Narberth, Pa.—Bids are asked until 8 p. m., Oct. 1, for laying 6 miles of 8, 10 and 12-in. terra cotta pipe sewers, with manholes, flush tanks, etc. E. C. Hawley, clk. coun.

Rock Island, Ill.—Sealed bids are asked until 5 p. m., Oct. 1, for constructing all sewers, drains, catch basins, manholes and appurtenances. Geo. W. McCaskrin, prest. bd. local impvts.

Baltimore, Md.—Bids are asked until Oct. 3 for building a testing plant, laboratory and for laying sewers. Wm. D. Platt, chmn. pro tem. sewerage comn.; E. Clay Timanus, prest. bd. awards.

Washington, D. C.—Bids are asked until Oct. 1 for furnishing 7,000 ft. 24-in. and 3,600 ft. 21-in. terra cotta sewer pipe, and until Oct. 18 for constructing sewers. H. B. F. MacFarland, chmn. Dist. Comrs.

Omaha, Neb.—Bids are asked until Oct. 8 for constructing South Omaha relief main sewer, embracing 3,700 ft. brick or concrete sewer 7 1-2 ft. and 800 ft. brick or concrete sewer 7-ft. in diameter. Dan B. Butler, cy. clk.

Robinson, Ill.—Bids are asked until Oct. 1 for constructing a sewage disposal system, consisting of 3 flush tanks, 1 septic tank, with concrete bottom and sides and ends of hard brick, and concrete and c. i. sewers. Henry Lewis, cy. clk.

Plainfield, N. J.—Bids are asked until 8 p. m., Oct. 1, for constructing 265 ft. 48-in. concrete, 280 ft. 33-in. concrete sewer, 54 ft. 15-in. inlet connections, 167 ft. 12-in. inlet connections, 6 branches, 180 ft. 4-in. c. i. house connections, 2 manholes and 8 inlets. Jas. T. MacMurray, cy. clk.

St. Mary's, O.—Sealed bids are asked until Oct. 3 for constructing a sewerage system about 15 miles in length, requiring 77,313 ft. 6, 10, 12, 15, 18 and 20-in. pipe; 5,000 ft. 4-in. house connections; 1,000 ft. 6-in. house connections; 1 pump well; 1 pump reservoir; 108.9 tons iron pipe; 3,000 lbs. iron specials; 153 manholes; 20 drop manholes; 68 flush tanks. H. W. Stearns, clk. B. P. S.

Plainfield, N. J.—Sealed bids are asked until 8 p. m., Oct. 1, for building 13,940 ft. c. i. sewer; 205 branches vitrified pipe sewer; 127 crosses on c. i. sewers; 37 manholes; 9 flush tanks; 500 ft. 4-in. c. i. house connections; 3 drop connections; 2,500 ft. 2 1-2 in. wrought iron air main; 2,500 ft. 8-in. c. i. force main; underground operating chamber for ejectors or displacement pumps; pumping plant, including electric motors, compressors, ejectors or displacement pumps and gasoline engine. Jas. T. MacMurray, cy. clk.

CONTRACTS AWARDED.

Providence, R. I.—The contract for a sewer in McKinley st. was awarded to Frank A. Gammino.

Duluth, Minn.—McAdam & Kern secured the contract for building a sewer on Exeter st. for $1,675.48.

Glendive, Mont.—John M. Baer was awarded the contract for constructing a sewerage system for $8,900.

Milford, N. Y.—The contract for constructing a sewerage system was awarded to John J. Tyne, of Binghamton.

Scranton, Pa.—The contract for constructing the 20th ward sewer was awarded to Vincent O'Hara, for $112,011.

Warsaw, Ind.—The contract for building a new sewer on E. Main st. was awarded to Silas Myers, for $4,492.

Bellevue, Ky.—J. B. McLane & Co. was awarded the contract for constructing a sewerage system for $61,941.13.

Tampa, Fla.—The contract for constructing sewers was awarded to Warren Bros., of this city, at 39 cts. a ft.

Lancaster, Pa.—The contract for constructing a concrete sewer was awarded to Stoll & Sons, of Altoona, for $90,000.

Reading, Pa.—L. H. Focht & Son secured the contract for constructing a storm water sewer on N. 11th st., for $8,999.92.

South Hadley Falls, Mass.—The contract for excavating for the new sewers was awarded to Daniel O'Connell Sons, of Holyoke.

St. Charles, Mo.—The contract for constructing a sewerage system was awarded to Wm. F. Hall, of Clinton, Mo., for $68,800.

Toledo, O.—The contract for a sewer on Monroe and Valley sts. Auburndale, was awarded to Breyman & O'Neill, for $35,111.25.

Helena, Mont.—The contract for constructing the Last Chance storm sewer was awarded to the Savage Co., of Tacoma, Wash., for $31,907.

Washington, D. C.—The contract for constructing a new sewer in Brightwood ave., N. W., was awarded to Lyons & Knott, for $10,563.75.

Junction City, Kas.—The contract for constructing a sewerage system was awarded to W. W. Cook & Son, of this city, for $74,919.71.

West Hartford, Conn.—F. B. and W. H. O'Neil, of Hartford, secured the contract for constructing 3,680 ft. of sewer pipe, for $3,358.

Salem, Mass.—The contract for constructing 130 ft. of 48-in. sewer, with valves, manholes and connections was awarded to Raymond H. Danforth.

Creston, Ia.—The Creston Plumbing & Heating Co. was awarded the contract for a storm sewer in the alley between Vine and Birch sts., at $1.22 a ft.

Paducah, Ky.—The contract for constructing a new sewer in District No. 2 was awarded to Thomas Bridges & Sons, of Wabash, Ind., for $119,750.24.

Lafayette, Ind.—John C. Frey was awarded the contract for 2,200 ft. of 10-in. vitrified pipe sewer, 6 manholes, 5 lampholes and 2 catch basins.

Boston, Mass.—James D. Fallon, 33 Crescent ave., was awarded the contract, Sept. 4, for constructing section 4 of the Stony Brook sewer, for $34,210.

Massillon, O.—Leininger & Rhine secured the contract for building sewers in Albright and Prospect sts. and Schott & Kraft for the Greene st. extension work.

Boise, Idaho—The Idaho Hardware & Plumbing Co. was awarded contracts for constructing sewer in districts Nos. 104, 105 and 106, for $25,759, $22,943 and $10,798.

Normal, Ill.—Patrick McDonald was awarded the contract for constructing sewers on School, Willow and Locust sts., Fell ave., and a 24-in. sewer in the creek bed, for $6,674.90.

Philadelphia, Pa.—Robert Lombardi has been awarded a contract for the extention of the Thomas Run sewer on Florence ave., for $20,000, and David Peoples the contract for reconstructing the old sewers through the grounds of Commercial Museum, for $30,000.

Covington, Tenn.—The bids submitted Sept. 11 for constructing a sewerage system here were as follows: P. H. Porter, of Clinton, Ky., $14,146.50; Contractor Coonan, of East St. Louis, Ill., $25,882.21; Miller Paving Co., Memphis, $15,463.20.

WATER WORKS.

Cleveland, Ok.—The Cleveland Waterworks Co. has been incorporated by C. A. Coper, Fred Cribby and J. E. Schell.

La Porte, Ind.—The Northern Trust Co. of Chicago has asked for a receiver for the La Porte waterworks plant, alleging the failure to pay up on $50,000 worth of bonds.

Phoenix, Ariz.—The corner stone of the Roosevelt storage dam was laid, Sept. 20, which marks the real beginning of the work. The stone weighs 6 tons and is laid 32 ft. below the normal river bed.

Niles, Mich.—The Association of Niles and Chicago Cottage Owners at Barren lake has asked the courts for a restraining order to prevent the Niles Water Supply Co. from taking any more water from the lake.

CONTEMPLATED WORK.

Shelton, Wash.—A concrete reservoir is contemplated.

Evanston, Ill.—A water meter system is contemplated.

Wilkes-Barre, Pa.—Will probably vote on the municipal waterworks proposition.

Decatur, Ill.—The estimated cost of the proposed waterworks system is $100,000.

Colfax, Ia.—About 1,800 ft. of iron water mains is contemplated. Wm. Cutler, cy. clk.

Woodland, Cal.—Will vote Oct. 2 on the issue of $10,000 bonds for the extension of water mains.

Clear Lake, Ia.—Will vote Oct. 8 on the issue of bonds for a deep well and a pumping plant.

Steelton, Pa.—The bd. of water comrs. has recommended the purchase and installation of a pump.

Chelsea, Mass.—The bd. of aldermen has appropriated $10,000 for installing water meters.

Natchitoches, La.—Improvements are contemplated to the waterworks and electric light plants.

Chardon, O.—Bids will be asked early next year for constructing waterworks and sewerage systems.

Corning, Cal.—The incorporation of this town, in order to secure waterworks, is contemplated.

Highland Park, Ill.—The extension of the waterworks intake is contemplated. John Finney, cy. clk.

Zanesville, O.—The improvement of the waterworks system is contemplated. P. J. Kerwin, clk. P. B. S.

Elkhart, Ind.—The Elkhart Water Co. contemplates 9,000 ft. of water mains extension and 18 additional hydrants.

Owensboro, Ky.—Votd to issue $60,000 additional bonds for extending the water mains. E. B. Schifley, cy. engr.

Chicago Hights, Ill.—The laying of 1 mile of 12-in. water mains is contemplated. John Gravelot, cy. clk.

Dallas, Tex.—City council has approved the estimates of the city engineer for water main improvements in Fair Park.

Los Angeles, Cal.—The water commission has decided upon considerable extension of the use of water meters by consumers.

Carthage, N. Y.—Will vote soon on the issue of $125,000 bonds for securing a pure water supply from Indian river.

McKeesport, Pa.—Bids will be asked for in 1907 for the proposed filter plant. T. H. Verner, supt. water & lgt. comrs.

Ironton, O.—Voted to issue $75,000 waterworks bonds, and a consulting engineer will now be employed. D. H. Clark, supt. w. w.

Ada, I. T.—An engineer will be selected Oct. 9 to have charge of the proposed water supply system. J. P. Wood, mayor.

Monroe, Wis.—City council authorized, Sept. 18, the issue of $85,000 bonds for the purchase of the plant of the Monroe Waterworks Co.

Presho, S. D.—The town bd. desires to grant a franchise for constructing a compressed air waterworks system. A. A. Karolevitz, town clk.

The question of issuing bonds for constructing waterworks systems will be voted on at the following places: Billings, Mont., Oct. 16; Hazelhurst, Ga.

Hamilton, O.—The board of public service is reported as consulting experts regarding plans for remodeling and improving the municipal water plants.

Wellington, Kas.—Special.—O. T. Reece, cy. engr., advises us that this city votes at special election on the issue of bonds for the improvement of the water system.

San Francisco, Cal.—The Bay City Water Co. has made a proposition to the board of supervisors to supply this city with water from the Sierra lakes, for $10,500,000.

Middletown, N. Y.—Will vote soon on the question of appropriating $110,000 for laying new water mains; $15,000 for enlarging filter plant; $500 for removing old roadway at Monhagan lake.

Birmingham, Ala.—The plans of the engineers employed by the Birmingham Water Works Co. provide for the damming of the Cahaba river; construction of an artificial fresh water basin; construction of a reservoir.

Waterloo, Ia.—Under the new franchise between this city and the Waterloo Water Co., artesian well water only can be furnished, and 4 new deep wells must be sunk for the purpose of ascertaining if it can be secured.

The question of issuing waterworks bonds has been favorably voted on at the following places: Addisville, Ga.; Greenfield, Ia.; Callaway, Neb.; West Selkirk, Man.; Battleford, Sask.; Elm Creek, Neb.; Wayland, Mich.; Cassopolis, Mich.

Tacoma, Wash.—Engineer H. J. Fuller was directed, at a meeting of the special water committee of city council, to ascertain accurately the flow of the South Tacoma wells, formulate a plan for increasing it if possible, devise a scheme to bring it up to 10,000,000 gals. a day, and find a method of conducting it to the city.

Atlantic City, N. J.—The finance committee has approved plans for building a 10,000,000-gal. pump, a 40-in. wooden main from the pumping station at Absecon to this city, erecting a standpipe on Chelsea Heights, and building artesian wells at Absecon for a source of water supply, and will ask council to appropriate $300,000 for the improvements.

The construction of waterworks systems is contemplated at the following places: Elwood, Neb.; Adams, N. D.; Atwood, Kas.; Stites, Idaho; Rolla, Mo.; Tuscaloosa, Ala.; Martinsburg, N. Y.; Jefferson, O.; Tifton, Ga.; Dadesville, Ala.; Wayland, Mich.; Stonington, Ill.; Scribner, Neb.; Ault, Colo.; Bovey, Minn.; Culbertson, Mont.; Troy, Idaho.

New York City—The new municipal water commission will advertise, according to press reports, on Oct. 1, for bids for constructing the first section of the new 90 mile aqueduct to the Catskills, and Nov. 1 for the second section, which extends from a point near Peekskill, across the Hudson river to East Hamburg, and will embrace the tunneling under the Hudson river.

Allegheny, Pa.—At a meeting of council, Sept. 10, J. Lenwood Brown, supt. bureau of water supply, recommended an increase of the water supply from 66,000,000 gals. to 75,000,000 gals. every 24 hours, by changing the three pumping engines at Montrose station from differential to double acting; a new crib with 4 intake pipes at Montrose; thorough cleaning of cribs in operation now; new lines of pipes on certain streets.

Chicago, Ill.—Plans for the systematic extension of the municipal water plant provide for the construction of a pumping station in Bowmanville, with a large 5 mile water supply tunnel leading to the lake; construction of a pumping station back of the stockyards, with a 9 foot tunnel leading from it to the big southwest land tunnel at 73d and State sts.; construction of a new pumping station at South Chicago, with a 9 foot tunnel leading north to the main line of the southwest land tunnel at 73d st. and Yates ave.

Monrovia, Cal.—O. K. Parker, C. E., who was employed by this city to investigate the municipal water system with a view to its improvement, has recommended the remodeling of the city pipe system, $10,000; improving mountain pipe system, $5,000; rebuilding and remodeling Chapman pumping plant, $35,000; domestic storage reservoirs in the canon, $30,000 to $50,000, depending upon the height of the dam; total, $80,000 to $100,000.

CONTRACTS TO BE LET.

Frederick, Ga.—Bids are asked until Oct. 4 for constructing a waterworks system.

Edinburg, Va.—Bids are asked until Oct. 2 for constructing a gravity waterworks system. W. A. Wrenn, chmn.

Dunnville, Ont.—Bids are asked until Oct. 2 for laying about 7,000 ft. of water main. J. W. Holmes, town clk.

Opelousas, La.—Bids are asked until Oct. 2 for boring an artesian well at the power house. B. A. Littell, mayor.

Pierre, S. D.—Bids are asked until Oct. 1 for constructing a large infiltration well. Edw. K. Mather, cy. engr.

Ft. Monroe, Va.—Bids are asked until Oct. 15 for constructing a steel water tank. Capt. R. H. C. Kelton, Q. M.

Manassas, Va.—Sealed bids are asked until Oct. 10 for constructing a waterworks system. O. E. Newman, chmn. constr. com.

Henderson, Ky.—Bids are asked until Oct. 4 for furnishing and erecting a pumping engine and boiler. Wm. Sieber, supt. mun. w. w.

Dalhousie, N. B.—Bids are asked until Oct. 3 for furnishing and laying 17,000 ft. 8, 10 and 12 in. conduit. Alex. J. Le Blanc, town clk.

Jamestown, N. D.—Bids are asked until Oct. 1 for relaying the water main on 5th st., from 6th to Pacific ave. John G. Bensch, cy. audt.

Cohoes, N. Y.—Bids are asked until Oct. 1 for furnishing and delivering a water power driven pump. H. L. Shever, prest. bd. water comrs.

Orange, N. J.—Bids are asked until Oct. 10 for constructing an addition to the pump house and furnishing boiler and water heater. Capt. Wm. D. Davis, Q. M.

Atoka, I. T.—Bids are asked until Oct. 8 for the purchase of all the material needed in the construction of a waterworks system. W. Bassett, mayor; O'Neill Engrg. Co., Dallas Tex.

North Yakima, Wash.—Bids are asked until Nov. 15 for constructing 12 miles of main canal in Tieton Canyon, near here. Supv. engr. Reclamation Service, Portland, Ore.

Chotau, Mont.—Bids are asked until Oct. 6 for constructing canals and dams for irrigation and reservoir purposes, about 15 miles northwest of here. Carlos Marfield, prest. Teton Co-Operative Reservoir Co.

Ft. Bliss, Tex.—Bids are asked until Oct. 15 for sinking a well, installing a deep well pump, constructing a deep well pump shelter and trestle, and a steel tank on a trestle. Lieut. C. O. Schudt, constr. Q. M.

Lockport, N. Y.—Sealed bids are asked until Oct. 8 for constructing a water supply system for this city, including an inlet crib at Niagara river; inlet pipe from crib to shore; pump well connected to inlet pipe at shore end; force main; steel standpipe; pumping station buildings, including machinery foundations; steam pumping machinery and boilers; electric pumping machinery. Howard M. Witback, mayor; E. S. Bennett, cy. clk.

CONTRACTS AWARDED.

Clintonville, Wis.—Ralph Mierswa, of Oshkosh, secured the contract for laying 2,070 ft. of 8-in. water mains, for $2,825.

Bloomfield, N. J.—The contract for extending the water mains was awarded to Pasquale Cestone, of Montclair, for $11,-512.50.

Fort Omaha, Neb.—The contract for reconstructing a new waterworks system here was awarded to Arnold C. Koenig, of Omaha, for $8,000.

Tecumseh, Ok.—The contract for constructing a waterworks system was awarded to the O'Neill Engineering Co., of Dallas, Tex., for $50,949.

Springfield, Tenn.—The contract for furnishing boilers for the new waterworks system was awarded to the Walsh & Weidner Boiler Co., of Chattanooga.

Provo, Utah—The Merrill Lumber Co., of Brigham City, was awarded the contract for laying wooden stave pipe for the waterworks system, at $1.68 3-4 a ft.

Asheville, N. C.—The contract for constructing a 5 million gallon water reservoir was awarded to the Farragher Engineering Co., of Cleveland, O., for $44,-462.

Lafayette, La.—The contract for the extension and renovation of the waterworks and electric light plants was awarded to Spranley & Roed, of New Orleans, for $25,400.

New Orleans, La.—The bid of Black & Laird, Ltd., of this city, has been recommended for acceptance for furnishing and erecting 2 complete water purification plants, including excavation, foundation, concrete masonry, reservoirs and filters, head houses, pumping stations building, wharf and intake, pipe and appurtenances, etc. The company's bid is $1,840,727.

BRIDGES.

Woodland, Cal.—A new bridge across Putah creek is contemplated.

Elyria, O.—Voted to issue $70,000 bonds to build 2 river bridges.

Kennet, Cal.—A new bridge will be built across Big Backbone creek.

Kokomo, Ind.—A cement arch bridge is contemplated at Palmer st. W. L. Benson, co. audt.

Newton, Ia.—Bids will be asked after Jan. 1 for a small steel bridge. E. Beau, co. audt.

Crooksville, O.—Bids are asked until Oct. 1 for building a steel bridge at Main st. Co. comrs.

Cleveland, O.—Will vote on the issue of bonds for building a new bridge across the river, Oct. 9.

Delphi, Ind.—Bids are asked until Oct. 11 for constructing two bridges. Fred H. Engel, co. audt.

Richmond, Ind.—Bids are asked until Oct. 1 for constructing 7 bridges. C. E. Wiley, chmn. comrs.

Sandusky, O.—Bids are asked until Oct. 3 for constructing a number of steel bridges. J. N. Traxler, co. audt.

Beatrice, Neb.—Bids are asked until Oct. 2 for constructing various county bridges. W. R. Copley, co. clk.

Richmond, Tex.—Will vote on the question of erecting a steel bridge over Bernard river at or near Schley's crossing.

Newbern, N. C.—Bids are asked until Oct. 2 for erecting a highway bridge across Nouse river. C. E. Foy, chmn. bd. comrs.

Woodburn, Ind.—County council has appropriated $20,000 for constructing a steel bridge over Maumee river, near here.

Sardinia, Ind.—Bids are asked until Oct. 1 for constructing a concrete arch bridge in Jackson twp. Co. comrs., Greensburg.

Ludington, Mich.—Will vote in November on issue of $50,000 bonds for constructing a draw bridge in the Washington ave. bridge.

Lexington, Miss.—Bids are asked until Oct. 1 for building a bent bridge across Lamberth Bayou. Parham Williams, clk. bd. co. supvrs.

Wichita, Kas.—Bids are asked until Oct. 1 for building various bridges of steel, reinforced concrete or wood. R. N. Dorr, cy. clk.

La Porte, Ind.—Bids are asked until Oct. 4 for constructing a bascule bridge over the harbor at Franklin st. in Michigan st. Co. comrs.

Salem, Mass.—Bids are asked until Oct. 8 for building a new bridge over Danvers river, between this city and Beverly. James P. Hale, clk. co. comrs.

Peoria, Ill.—The contract for building a new 1,100-ft. Melan arch bridge was awarded to the J. B. Marsh Bridge Co., of Des Moines, Ia., for $150,000.

Indianapolis, Ind.—Bids are asked until Oct. 6 for erecting 6 bridges and 2 culverts. Thos. E. Spafford, chmn. co. comrs.; Cyrus J. Clark, co. audt.

Winnipeg, Man.—Bids are asked until Nov. 20 for erecting a steel superstructure for a highway bridge over Red river at Redwood ave. J. G. Latimer, chmn. com. on works.

Bluffton, Ind.—County council has appropriated $15,000 for a new bridge across Wabash river at the foot of Main st.; a smaller bridge a short distance north of the large bridge.

Winchester, Va.—Bids are asked until Oct. 10 for building a concrete or steel bridge over Opequon creek, between this city and Berryville. P. McCormick, secy. Berryville Turnpike Co.

Indianapolis, Ind.—The contract for constructing 26 bridges in Marion county was awarded, Oct. 15, to Velp & Felz, Henry L. Harding, H. F. Hackerdorn & Co., Marion Construction Co., and Theodore Frazier.

Dayton, O.—Bids are asked until Oct. 4 for removing the present bridge across Miami and Erie canal at Pearl st., Miamisburg, and erecting a new automatic swing bridge; also, for erecting an automatic swing bridge across Miami and Erie canal on Kreitzer road in Van Buren twp. T. J. Kaufman, co. audt.

Wellington, Kas.—Special.—O. T. Reece, co. surv., says the county comrs. are asking for bids for 2 new bridges, one an 80 ft. span steel with reinforced concrete piers, and two 80-ft. span bridge on concrete piers. A contract has been let for an 80-ft. span bridge on reinforced concrete piers to the Wichita Bridge Co. for $1,690.

STREET LIGHTING.

Brandon, La.—An electric light plant is contemplated.

Ashland, Wis.—A municipal lighting plant will be established.

Tyro, Kas.—Voted to issue bonds for installing municipal gas mains.

Oriskany, N. Y.—The question of constructing an electric light plant is being considered.

Chattanooga, Tenn.—The Connally-McIlheran Electrical Engineering Co. has been incorporated.

Jonesville, La.—The town council contemplates establishing a municipal electric light plant.

Covington, Ind.—The plant of the Covington Light & Water Co. was destroyed by fire Sept. 13.

Burr Oak, Mich.—Village council granted an electric light franchise to Edgar Seaver, of this city.

Miami, Fla.—The Miami Gas Co. is preparing to build a gas plant, for which it recently obtained a franchise.

Carlisle, Ind.—A franchise for an electric light plant has been granted to Thos. A. Grizzle and Chas. W. Lisman.

Greenville, Ill.—The Greenville Gas Co. has been incorporated by Emanuel D. Heyde, Alonzo E. Dunn and Melissa Heyde.

Rushville, Ind.—City council has decided to let contracts for the improvement of the city electric light plant.

Manassas, Va.—Sealed bids are asked until Oct. 10 for constructing an electric light plant. O. E. Newman, chmn. constr. com.

Fargo, N. D.—Bids are asked until Oct. 2 for apparatus for the lighting plant of the county hospital. Arthur G. Lewis, co. audt.

Louisville, Ky.—A modern power house is to be erected on the site of the old jail, to supply the city buildings with light and heat.

Rosalia, Wash.—Arthur D. Jones and associates of Spokane are trying to get a franchise for furnishing this town with electricity.

Lynchburg, Va.—Bids will be asked soon for the equipment for the proposed electric light plant for this city. A. L. Shaner, cy. engr.

Kenney, Ill.—The Kenney Electric Co. has been incorporated to furnish light and power, by Andrew Harkyard, Wm. E. Cooer and Louis O. Williams.

Washington, D. C.—Bids are asked until Oct. 9 for furnishing the Navy Dept. with electrical supplies at the various yards. H. T. B. Harris, paym. genl.

Kansas City, Mo.—The Business Men's League has asked the city council to purchase the gas plant of the old gas company and build a municipal plant.

Wellington, Kas.—Special.—O. T. Reece, cy. engr., says that this city will vote at special election on the issue of bonds for remodeling the electric light plant.

Salt Lake City, Utah—The Salt Lake Public Service Co. has been incorporated and will take over the franchise for light, heat and power granted by the city council.

Niagara Falls, N. Y.—The Ontario Power Co. will increase the capacity of the plant by adding 3 more generators with turbines to run them. Francis V. Greene, prest.

Fort Wayne, Ind.—The Fort Wayne Artificial Gas Co. rejected, Sept. 15, Mayor Hosay's offer of a franchise for 80-ct. gas. The company wants 90 cts. as the maximum price.

Abilene, Tex.—The Abilene Gas Light, Fuel & Power Co. has been incorporated to build and equip gas plants, by G. Thorne, H. C. Messimer and R. L. Messimer, all of this city.

Montreal, Que.—The Sovereign Light & Power Co. has made a proposition to the city to supply gas at 85 cts. per thousand cu. ft. and electric lights at present rate, less 33 1-3 per cent. discount.

Quogue, N. Y.—The Quogue Gas Co. has been incorporated by Abram S. Post, Erastus S. Post and Henry Gardiner, of Quogue, and David C. Townsend, Chas. H. Smith, Wm. M. K. Olcott and Jas. K. Burnham, of New York City.

Milwaukee, Wis.—City council has appropriated $60,000 from the $150,000 light bonds for the purchase of a light plant site, and voted to have the bd. of pub. wks. to have an expert to prepare plans and specifications for a plant.

Portland, Me.—The Ash Meadow Water Co. has been organized here for the purpose of developing and operating water power and privileges in the states of Nevada and California, by Jas. C. Kipp, of Pittston, Pa.; Edward H. Sleafer, Scranton, Pa.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Freeport, L. I., N. Y.—The Rural Sanitation Co. has asked the bd. of vil. trustees for a franchise to construct and operate a plant for the disposal of garbage.

Utica, N. Y.—The contract for cleaning the streets for 5 years was awarded, Sept. 7, to Harry W. Roberts & Co. for $13,574 per year for District 1; $13,724 for District 2; $12,107 for District 3.

PARKS.

Pittsburg, Pa.—A site for a park in the 32d ward is being considered.

Woodland, Cal.—Will vote Oct. 2 on the issue of $8,000 bonds for parks.

Chicago, Ill.—Plans have been prepared for small park No. 4.

Cleveland, O.—City council will purchase more land for additions to the public park system.

Jersey City, N. J.—The street and water bd. has decided to establish a playground in Lafayette Park.

Albany, N. Y.—Capitalists of this city, headed by Wm. Bookheim & Sons, 230 S. Pearl st., have purchased the lease of the pleasure park, known as Lagoon Island, situated on Hudson river between this city and Troy. They contemplate expending $100,000 in improving the park and transforming in into an up-to-date pleasure resort with attractions similar to those at the Coney Island resorts.

FIRE APPARATUS.

Washington, D. C.—Bids are asked until 10:30 a. m., Oct. 2; for a fire alarm telegraph system. D. W. Ross, genl. purchasing officer, Isthmian canal comn.

Memphis, Tenn.—Bids are asked until Oct. 4 for furnishing 5,000 ft. 2 1-2 in. double jacket rubber-lined hose; 1,000 ft. 2 1-2 in. 5-ply rubber hose. J. T. Walsh, acting mayor.

Mankato, Minn.—Council voted to buy 1,000 ft. fire hose. Information will also be secured regarding a new fire truck.

Missoula, Mont.—Bids are asked until 12 m., Oct. 1, for 2,000 ft. 2 1-2 in. cotton hose. J. S. Kemp, cy. clk.